Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

VOL. 75—No. 11. CHICAGO, SATURDAY, SEPTEMBER 13, 1919. PAGE 423.

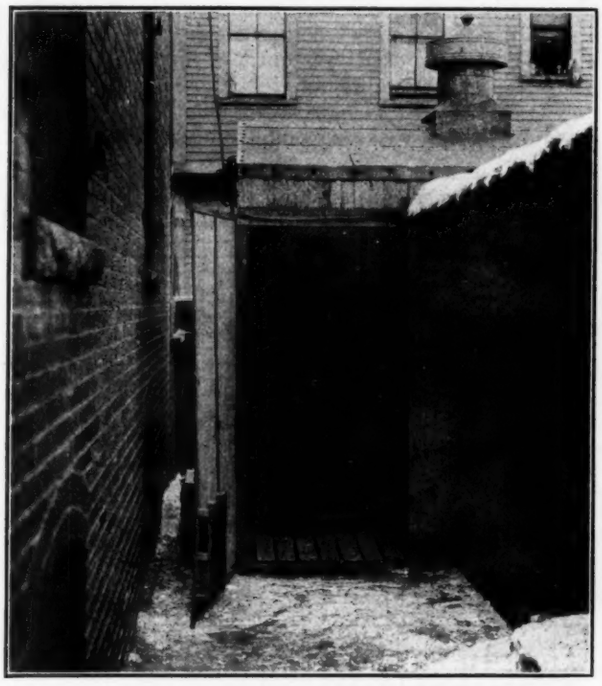

Fig. 1.—Galvanized-Iron Structure Housing Static Condenser Outdoors.

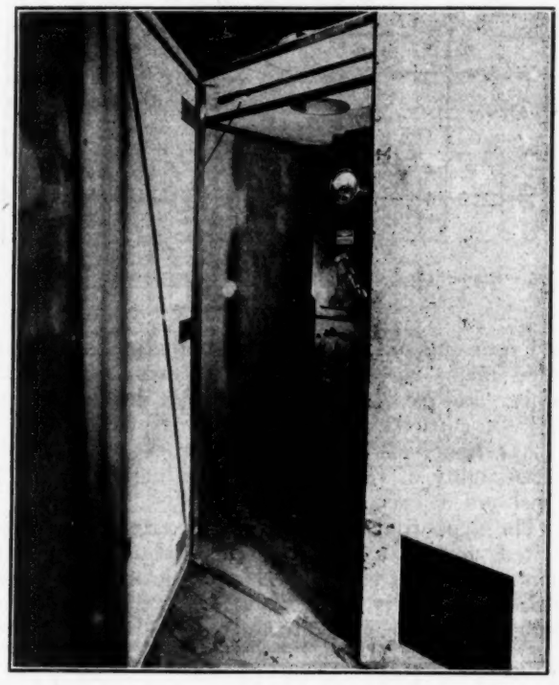

Fig. 2.—Asbestos Housing for 100-Kv-a. Static Condenser Installed Indoors.

Power-Factor Correction by Use of the Static Condenser

Characteristics of Static Condenser Installations—Causes of Low Power-Factor — Operating Costs and Purchase Price — Paper Before Pennsylvania Electric Association

By O. C. ROFF

General Electric Co.

THE importance of maintaining a high power-factor on the system is generally recognized by operating companies. Low power-factor represents a purely economic loss with a consequent reduction in efficiency. The law of conservation demands that equipment should be made to serve to the limit of its capacity, and to accomplish this it follows that alternating-current apparatus should operate at the highest possible power-factor.

The detrimental effects of low power-factor conditions are similar to an insidious disease, and often become a distinct menace before the gravity of the situation is appreciated.

While in all instances the character of the load imposed on the distribution system should be carefully scrutinized, and preventive measures taken wherever possible to avoid an undesirable power factor, it frequently happens that such precautions alone are not sufficient. It is then necessary to adopt some corrective means and the static condenser offers a solution of the problem in many such cases.

FEATURE OF STATIC CONDENSER INSTALLATION.

The static condenser, as the name implies, is devoid of any moving parts and is extremely simple in operation, requiring practically no attention aside from throwing the necessary control switches to connect or disconnect the apparatus from the system. The

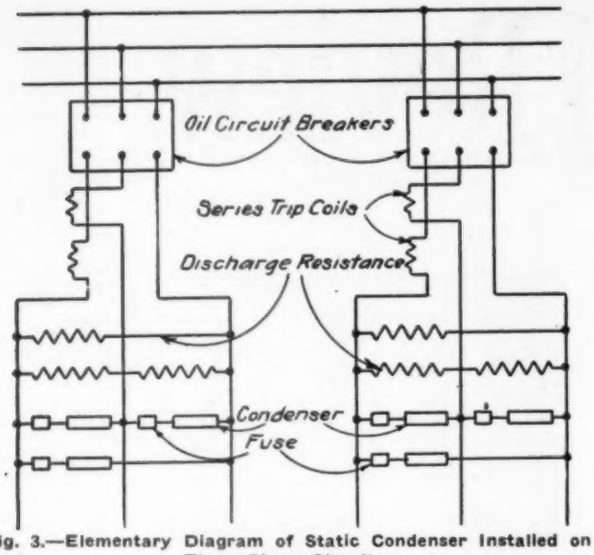

Fig. 3.—Elementary Diagram of Static Condenser Installed on Three-Phase Circuits.

condenser units are immersed in oil in hermetically sealed metal cases and mounted upon racks. The number and grouping of the units is dependent upon the kv-a. capacity and the number of phases.

A series reactance for the purpose of excluding all possibility of resonance with the higher harmonics is inserted in each phase.

The synchronous motor or converter, when over-excited, acts as a capacity for the fundamental frequency, but is dead for the higher harmonics, and the static condenser is made equivalent to the synchronous condenser by the introduction of this reactance.

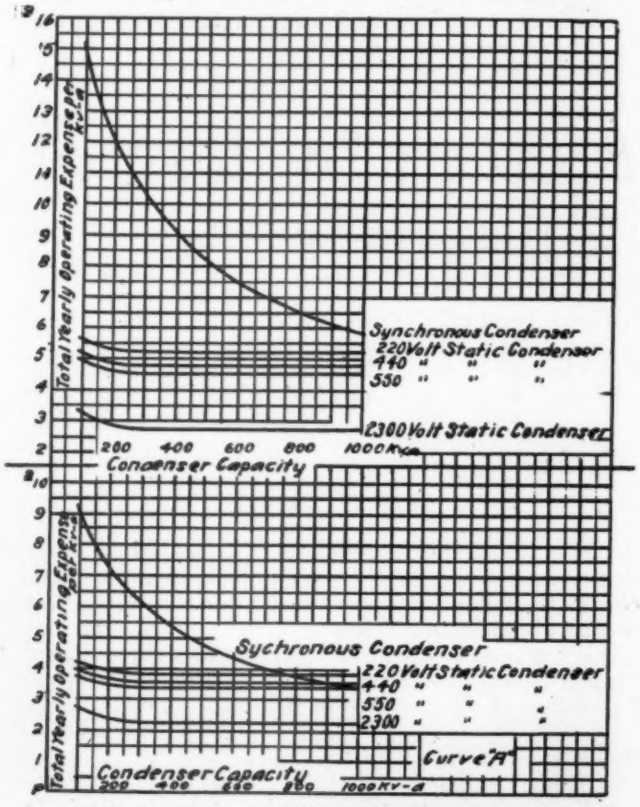

Fig. 4.—Total Yearly Operating Expense per Kv-a./Kv-a. Capacity on Basis of Full-Load Operation 7000 Hrs. per Year. Capital Charge 15% per Year of Purchase Price.

Upper Curves: Losses charged at 1½ ct. per kw-hr. Lower Curve: Losses charged at ¾ ct. per kw-hr.

Discharge rods of high resistance are arranged across each phase of the equipment, where required, so that when disconnected from the system any charge will be dissipated.

As an additional precaution for the protection of the condenser units, and to increase the reliability factor of the equipment, a fuse element is inserted in series with each unit.

On account of the active element of the condenser units being immersed in oil, the insulating properties are greatly increased, which consequently insures long life with resultant low maintenance. The equipment can easily be housed for outdoor installation along transmission lines or remote locations.

Static condensers can be arranged for mounting in tanks to provide for subway installation, or in

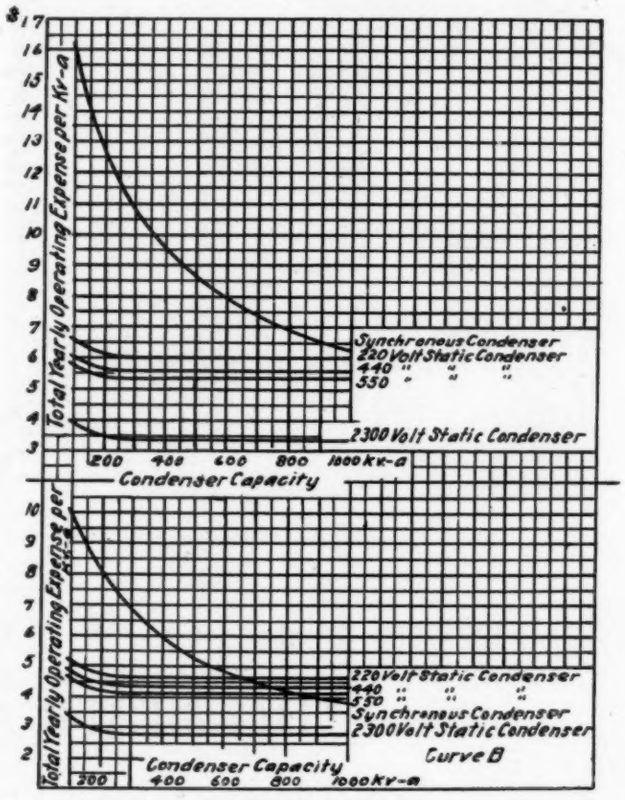

Fig. 5.—Total Yearly Operating Expense per Kv-a./Kv-a. Capacity on Basis of Full-Load Operation 7000 Hrs. per Year. Capital Charge 20% per Year of Purchase Price.

Upper Curve: Losses charged at 1½ ct. per kw-hr. Lower Curves: Losses charged at ¾ ct. per kw-hr.

capacities up to approximately 20 kv-a. for pole mounting.

The equipments have been standardized in capacities from 60 to 300 kv-a., preferably in 60 kv-a. steps, and for all commercial voltages from 220 to 2300 volts.

As it is impossible to produce an economical design for 550 volts or below for direct operation, it is necessary to utilize autotransformers for stepping up the potential for the condenser units.

The frequency of the circuit is also closely related to the characteristics of the equipment, due to the fact that the current in a condenser with a given voltage is dependent upon the frequency. By reason of this, static condenser outfits become correspondingly expensive on frequencies less than 40 cycles.

An elementary diagram of the equipment is shown

in Fig. 3. The simplicity is a factor which produces a low maintenance.

The following summary of the pertinent characteristics of the static condenser render it particularly adaptable as a power-factor corrective device:

(1) Total absence of moving parts insure practically noiseless operation.

(2) Due to the simplicity of its control and operation, which amounts to merely connecting or disconnecting the apparatus from the system through the medium of an oil switch, the minimum amount of operating attendance is required.

(3) By virtue of their construction, condenser equipments can be installed in remote locations or distributed over the system in small units as the situation may demand. This puts the correction at the source of the poor power-factor, and allows the maximum advantage to be obtained, as the transmission losses of the wattless component are eliminated.

welding equipments, underloaded induction motors, and unwieldy distribution networks, composed of oversized transformers.

Naturally, lightly loaded transformers introduce considerable reactance into the system, and when low power-factor exists excessive current must be transmitted with the consequent necessity of increased transformer capacity. It follows, therefore, that such transformers under light load at off peak periods tend to still further reduce the power-factor. A large number of such oversized transformers distributed over the system are consequently productive of a greatly lowered over-all system power-factor.

While the regulation of transformers is inherently good, nevertheless it is a factor which is considerably affected by low power-factor conditions.

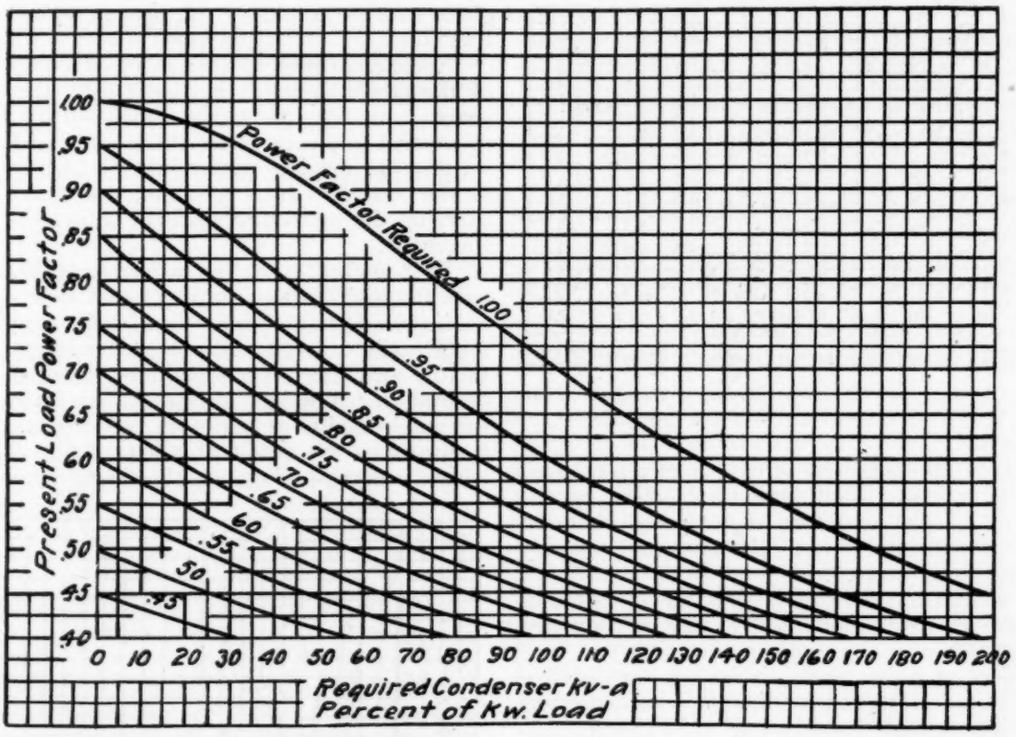

Fig. 6.—Curves Showing Condenser Kv-a. Required for Any Desired Power-Factor Correction in Per Cent of Existing Kilowatt Load.

(4) No expensive foundations are necessitated for the installation.

(5) The high efficiency of the apparatus, better than 99% for direct application, results in good operating economy which when capitalized is a valuable asset.

The location of the equipment is of paramount importance, for to secure the best results the correction should be made at the source of the wattless current and thus avoid the transmission of this component, thereby decreasing line copper losses.

It might even be found advantageous on long feeders with a large number of distribution circuits emanating therefrom, to install small condenser units with each distribution transformer, thereby obtaining a balanced corrective effect over the entire network. Such an arrangement would obviate the transmission of wattless current, and in many instances be preferable to confining the corrective apparatus at a central distribution point.

Causes of Low Power-Factor.

The conditions producing low power-factor are many and varied, such as electric furnace loads, arc

Small lighting transformers have a regulation ranging from 1½ to 2% at unity power-factor with a reduction in this characteristic of from 4 to 5% at 70% power-factor. In the case of larger units, with a regulation of 1%, this value would be lowered to 3% at 70% power-factor.

The detrimental effects of a poor power-factor are even more apparent in generators than in transformers and is productive of both a decrease in kilowatt capacity and efficiency. Not only will such a condition impair the voltage regulation, but often demands increased exciter capacity to overcome the demagnetizing tendency of the lagging power-factor current set up in the armature.

As a consequence the field heating of alternators is greatly augmented, while the increased energy input and decreased energy output considerably lowers the efficiency.

It is, therefore, evident that a relatively high leading power-factor is more efficient than a low lagging power-factor, for the voltage will be maintained at a higher value with a corresponding decrease in excita-

tion, owing to the fact that the generator will be partially excited by the capacity current in the armature winding. The detrimental effect of low power-factor is further emphasized when it is considered that the regulation of modern alternating-current generators is approximately 14% at unity and drops to 30% at 70% power-factor.

The question of the flexibility factor of the static condenser is closely related to the foregoing, but it

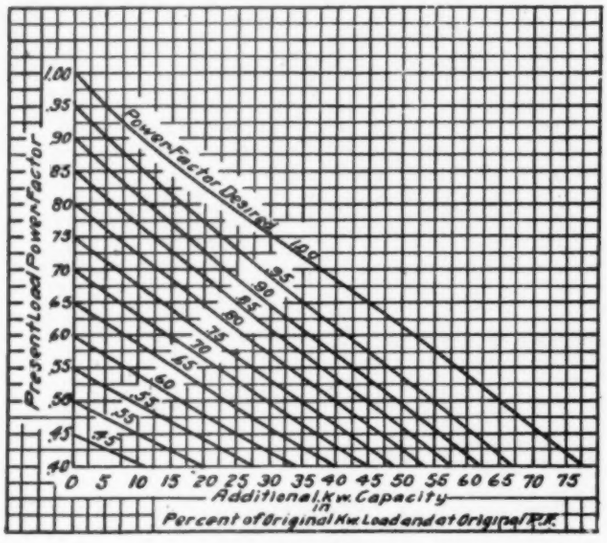

Fig. 7.—Curves Showing Additional Kilowatt Capacity Made Available by a Given Correction of Existing Power Factor.

will be found in the majority of cases that the reduced power-factor at light load periods is offset by the comparatively high condenser capacity, so that the power-factor will improve at this point and possibly advance to a leading value.

If, in extreme situations, automatic operation is justified, it can be accomplished by the introduction of a time switch or other automatic features.

The effect of lower power-factor on the distribution circuits is even more pronounced as evidenced by the following example:

Assume that a load of 100 kw. is to be transmitted a distance of two miles at 2300 volts, three-phase, 60 cycles, with an energy loss of 10%—each conductor at unity power-factor would require an area of 25,000 c.m., at 0.9 power-factor 30,820 c.m., while at 0.60 power-factor it would necessitate the use of 69,500 c.m.

It is thus apparent that it will require 2.8 times as much copper at 60% power-factor as at unity.

If the initial cost is capitalized, it will be found that the increased copper demanded will cost somewhat less than a static condenser of sufficient size to accomplish the same result, but it is evident that the gain in the available capacity of generators, transformers and lines would justify such cost differential.

A few of the benefits derived from an improvement in power-factor may be summarized as follows:

(1) Makes possible the meeting of increased demands without the purchase of additional generating equipment, and this refers not only to the generators themselves, but to the necessary prime movers and auxiliary apparatus.

(2) Permits additional load being carried on existing distributing feeders, which might otherwise be fully loaded with the low power-factor existing.

(3) Effects a material saving in present transmission losses.

Operating Costs and Purchase Price.

The extremely moderate operating cost and approximate prices of static condenser equipments are illustrated by the curves shown in Figs. 4 and 5.

The total yearly operating expense referred to in the curves comprises two items, one a capital charge at some assumed percentage of purchase price of the equipment in question, and the other representing the cost of furnishing the losses of the equipment at an assumed number of hours per year operation at full load charged at a stated price per kilowatt-hour.

Application of the Static Condenser.

The determination of the size of a static condenser equipment required to correct the power-factor of a given load is graphically illustrated by the curves in Fig. 6.

A concrete idea of the saving made by correction of the power-factor is emphasized by the curves appearing in Fig. 7, which show with a given improvement in power-factor the amount of load in kilowatts at the original power-factor which can be added to the system. It is assumed that the circuit was carrying the maximum amperes before the correction was made.

If, however, when the correction is accomplished, only the load on the circuit at that time was considered, the addition of more load at the original power-factor will cause a consequent reduction in power-factor, and this point should be considered, if it is desired to maintain a certain power-factor and keep the line loaded to a maximum carrying capacity. Fig. 8 illustrates the resultant power-factor for different corrections, assuming that the line is again loaded to

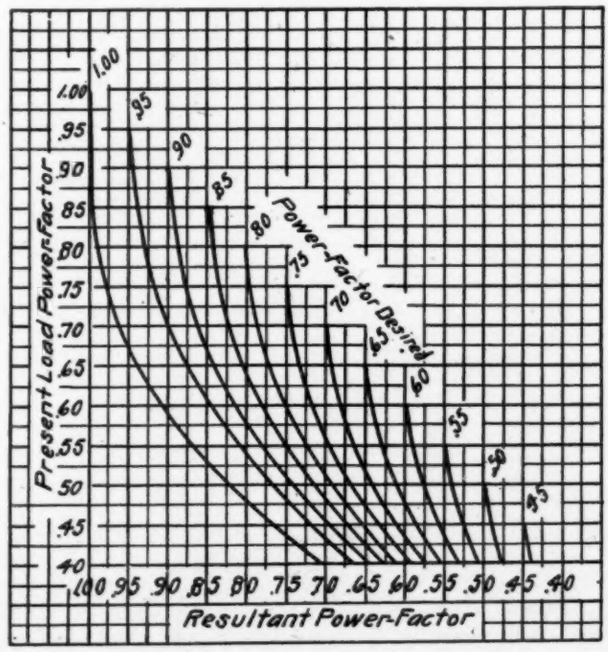

Fig. 8.—Curves Showing Resultant Power-Factor.

Determined by original load at corrected power-factor plus additional load at original power-factor so that total kilovolt-amperes of circuit is equal to original kilovolt-amperes.

capacity. The solution of practically any power-factor problem may be developed from the use of the curves appearing in Figs. 6, 7 and 8.

The problem of power-factor improvement is at

the present time closely allied with the question of rates, and numerous remedies for bettering conditions are either being utilized or are under consideration. Prominent among such corrective measures are the enforcement of power-factor penalty clauses or metering on the kilowatt-ampere basis.

The rapid growth in load so frequently encountered illustrates the necessity for a rather generous attitude on the part of the public toward the utility, so that the increase can be properly taken into account and the best interest of both the public and company conserved.

The importance of power-factor is appreciated more and more by engineers, but there is still the need for more organized co-operative effort toward the betterment of power-factor conditions in alternating current systems. This tendency is particularly apparent in many sections of the country, especially where large individual users of power are scattered over the system, and without doubt will ultimately be more seriously considered as a vital element of power distribution and transmission.

FRENCH MARKET FOR ELECTRICAL GOODS.

Report by American Chamber of Commerce in France.

In a recent report made by American Trade Commissioner Charles P. Wood during his investigations in France in regard to the possibilities of marketing American electrical goods, he stated that prior to the war a considerable amount of electrical goods was imported from Germany by French dealers in competition with other dealers handling French-made goods. It is thought that most of the inquiries in this line now come from the former class of dealers, who have lost their connections and who, naturally, have no claim on French manufacturers already represented.

American underwriters' standards are not necessary in France. French houses are more nearly fireproof than American houses and the same precautions do not have to be taken. American dealers exporting to France will have to furnish French patterns in several fittings that differ essentially from American practice. Among the more common instances will be: Bayonet sockets instead of screw sockets, tumbler switches instead of snap switches, sheet-metal tube with crimped joint and lined with treated paper instead of heavy metal conduit. This light conduit employs sleeve unions instead of screwed joints.

There have been inquiries regarding the conduit mentioned above, which is scarce in France at present. Other inquiries refer to: Multipolar snap switches, flush-type push button switches, all fittings requiring hard rubber in their manufacture, high-candlepower low-volt incandescent lamps for motion picture machines.

While there is a certain demand for the importation of electrical goods in France at present, and while it is undoubtedly worth while to solicit this business and to take orders, if possible, it is also well to bear in mind that there are French factories well equipped for making a full line of electrical goods and that their production will be on the increase. Therefore orders taken during the present emergency, should not be considered an indication of a considerable future demand, except in the case of specialties controlled in America.

NEW HYDROELECTRIC INSTALLATION FOR MADAGASCAR.

Plant of 3000-Hp. to Be Built with Fifteen-Mile Transmission Line.

The installation of a water and electric-light system for Tamatave, the principal port of Madagascar, is under consideration by the authorities and the project has the approval of the Governor General.

The electric current is to be furnished by waterfalls situated 10 to 15 miles west of Tamatave, in the Ivondronó river. In view of the capacity of these falls, estimated at 3000 hp., it is agreed that in addition to the municipality of Tamatave the colony of Madagascar and dependencies should also become interested, and that this water power should be made available in order to furnish power for the general future needs of the colony in connection with such important undertakings as the electrification of the railway from Tananarive to Tamatave, a distance of 229 miles, electrometallurgical and electrochemical industries, etc. It is proposed, therefore, that the colony undertake the harnessing of this water power, which would necessitate the building of a dam, reservoirs, canals, and a power plant. The obligation of the municipality will thus be reduced to the installation of two groups of turbines to furnish 500 kw. of alternating current, power cables, transformers, and the distribution of water in the town of Tamatave. The colony's expenses in this connection will, it is estimated, be $120,625, and those of the municipality of Tamatave $236,425.

It is being considered whether it will be better to have all of this work done under contracts to be awarded on bids or to have it undertaken by the local services. Whatever might be decided, however, it is admitted that the first part of the work—that which is to be undertaken by the colony—should be awarded only to contractors in the colony, and proposals for the second part should be submitted concurrently in the colony and in France. As a rule, all contracts for public works in Madagascar are awarded to French citizens only.

INTERESTING BOOKLET DESCRIBES CHICAGO ELECTRICAL SHOW.

Amusing Report by Well-Known "Japanese School Boy" Describes Features of Coming Exposition.

An interesting and amusing pamphlet entitled "The Japanese School Boy Learns of the Land of the Wonderful Lamp" is being distributed by the Electrical Trades Exposition Co. describing the Electrical Show to be held in Chicago Oct. 11 to 25. In this pamphlet the Japanese school boy, originated by Wallace Irwin, relates in his most amusing style an interview with E. W. Lloyd, general manager of the show, in which he describes its features and attractions, and supposedly is given the Herculean task of arranging the display before the show and of serving tea to its lady visitors.

The booklet is attractively illustrated with views of the various Chinese display booths, all of which are pleasingly decorated and designed to fit into the general decorative scheme.

Copies of this booklet can be obtained by writing E. W. Lloyd, general manager of the Chicago Electric Show, Edison building, Chicago.

Practice in Making Electric Utility Appraisals

Discussion of the Value of Unit Costs and Necessity for Care in Their Preparation — Practical Methods of Appraising the Land, Buildings and Pole Lines

By CHARLES W. McKAY

Chief Appraisal Engineer, L. V. Estes Incorporated, Chicago.

THE importance of the subject of unit costs in appraisal work can hardly be exaggerated. No matter how carefully the inventory may be prepared, nor how accurate it may be, it is worse than useless if the unit costs used in its appraisement are faulty. To illustrate:

Let us assume that a certain electric utility plant contains 1000 30-ft. 7-in. poles and that the field men in recording the inventory have observed the utmost detail in describing the condition of the poles, noting whether or not they are stepped, painted, butt-treated, etc., in short that the inventory represents an extremely accurate record of the conditions actually existent in the plant. Such an inventory should result in a splendid appraisement, if reasonable care is exercised in preparing the unit cost. Obviously, it will be necessary to derive but one unit cost and this cost will be multiplied by 1000 to obtain the total cost of the 1000 poles. Hence, even a slight error in the preparation of the unit cost may result in a grievous error in the appraisement. Assume that due to some mistake in computation, or in the basic assumptions, the unit cost is $1.50 too low. There will be a resultant appraisal error of $1500.

Suggestions for Making the Appraisement Dependable.

IN previous articles of this series it has been shown that valuation of the utility's property is a usual accompaniment of rate cases in which the utility is involved. This valuation must be quite accurate and yet made with reasonable speed and at as moderate a cost as possible. The first feature in the valuation is the inventory and this Mr. McKay discussed in his last article (see August 9 issue), showing methods for systematic counting and recording of the data. In the present article he makes valuable suggestions for determining accurate unit costs to facilitate setting down the actual appraisement figures.

This article is the fifth of a series of twelve by Mr. McKay covering the subject of valuation and rates, as related especially to electric central-station companies. The first article appeared in the issue of May 17 and presented a general introductory discussion of modern ideas of utility regulation. In the second article (issue of June 7) there was a compilation of the principal terms used in this work and definitions thereof. Why reproduction cost is now used as the basis of appraisement was discussed in the third article, in the June 28 issue. The actual inventory was the topic taken up in the fourth article, August 9 issue. Several other articles dealing with appraisement will be included before other topics bearing on rate-making will be taken up.

Throughout this series it is the author's aim to present the principal features of valuation and rate-making in a simple and understandable manner that will make clear to the central-station manager and engineer, as well as others interested in the subject, the fundamental basis of modern practice in utility regulation.

Methods of Determining Unit Costs.

The unit cost, it should be remembered, includes not only the cost of material used in plant construction but also the cost of the labor necessary to install such materials as a part of the operating plant.

As a prelude to a more detailed discussion of the subject of unit costs, it may be well to say that there are two prevalent methods of determining the costs used in electric utility appraisement. One of these methods is known as the "trend method" and the other as the "average method."

In the trend method curves are plotted showing the prices prevalent for the various materials used in electric utility construction; the slope of these curves is determined for the period immediately antedating the appraisal and the curves are extended, or projected, to predict future material prices. A similar process is followed with respect to labor costs. In other words, when it comes to a final determination of the unit cost, the *trend* of material and labor costs is considered.

This method has not found favor with many of the state commissions and for this reason it will only be mentioned as a factor in public utility appraisement. No attempt will be made to enter into a discussion of the merit of this method, as advanced by its defenders. The writer is of the opinion that the trend method is obsolescent and quite unsuitable for use in these days of abnormal prices.

In the average method of determining electric utility unit costs, a careful investigation is made of all material and labor costs for a period of five years or more antedating the appraisal and the results obtained by averaging these costs are used as a basis for determining the unit costs. The word "basis" is used advisedly in this connection. The exact average as obtained by the consideration of the costs prevalent over a given period is not always suitable for use in appraisal work. The individual peculiarities of every case must be considered and an effort made to so reconcile these peculiarities as to determine a *fair* cost. Such a fair cost may, or may not, be an average cost, although in applying the average method the *average* cost is a guiding factor in determining

what is to be taken as the actual fair cost in the particular case.

With this brief resumé of the theory of the unit cost derivation we may proceed to a consideration of the appraisement of the inventory discussed in the issue of the ELECTRICAL REVIEW for August 9.

LAND APPRAISEMENT.

It is interesting to note that several of the leading public utility commissions have taken the stand that neither the utility companies nor the engineers who represent them are competent to testify as to land values. In the writer's opinion this point is not well taken, but nevertheless it is well to bear it in mind in preparing a case for presentation before a commission that has put itself on record as holding such a prejudice. Be it understood that the foregoing statement is by no means intended as a criticism of the method of procedure of any commission—the fault may be laid at the door of several members of the engineering profession who have floundered in their testimony as to land appraisement, to the discredit of the entire profession.

Use of Land.—There has long been a difference of opinion between public utility appraisal experts as to whether or not *use* should be a factor in the determination of the value of the land occupied by electric utility companies. One faction argues that there is no real reason why land, or right of way, belonging to, say, an electric railway company, should be treated any differently from land belonging to a private individual. The other faction argues that the mere fact that the railroad is present raises the values of adjoining properties and therefore automatically raises the value of the land, or right of way, under appraisement. There is undoubtedly much to be said in favor of this argument, but one point should be carefully borne in mind and that is that if this policy be adopted in one case it must, to be consistent, be adopted in all cases, at least in the same appraisement. While the presence of an electric railway may increase surrounding property values it is equally true that the presence of a large central station using soft coal, let us say in a residential district, may cause a decrease in surrounding property values and the utility company owning the central station must suffer a depleted valuation of its land.

The attitude of the courts on this subject is evidenced by the following quotation from the case of Columbus Southern Railway *versus* Wright (151 U. S. 481):

> "The value of the land depends largely upon the use to which it can be put, and the character of the improvements upon it."

Method of Appraising Land.—Two methods have been advanced for the appraisement of land in public utility rate cases, the one known as the "expert method" and the other as the "sales method."

The expert method consists in the appraisement and description of the land by one or more competent real-estate experts, or appraisal engineers, the valuation as thus determined being substantiated by expert testimony on the witness stand. Sometimes a modification of this method is adopted by having a local real-estate expert make a valuation of the land, submitting his findings to the commission, and subsequently to have the appraisal engineer make an entirely separate investigation and submit his findings to the commission. The commission's engineer, having both of these valuations before him and having cross-examined the witnesses to his entire satisfaction, may take upon himself the problem of assigning the final value of the land to be included as evidence in the rate case.

Again, it may happen that as many as three or four experts may be called upon to evaluate the same parcel of land. Subsequently their valuations may be compared and a final value assigned by the appraisal engineer as evidence to be presented to the court or commission.

The sales method of evaluating public utility land requires a careful study of land values in the territory contiguous to the land under appraisement and as a result of this study the derivation of a unit cost to be used for valuation purposes. This unit cost may consist of a cost per square foot, cost per front foot, or a cost per acre as the case may require. The value of the adjoining land is determined by examining records of sale or transfer at a time as nearly coincident as possible, to the date of appraisement. In some cases tax-assessors' valuations are used as a basis for determining the unit.

In a decision, dated March 8, 1910, the Wisconsin Railroad Commission (in the case of State Journal Printing Co. *versus* Madison Gas & Electric Co.) discussed the sales method of evaluating real estate at some length. The case is a historic one and excerpts from the Commission's decision are quoted herewith.

> "The sales method of valuing real estate was used partially in the Michigan railway appraisals of 1900-01, and in the light of the experience gained in that work the method was adopted in the Wisconsin steam-road valuation made under the provisions of the ad-valorem-assessment law of 1903. It has since been extensively used in Wisconsin and elsewhere in connection with important valuations of public service properties for both rate-making and taxation purposes, and is generally accepted as a valuable aid to the judgment by experts engaged in such valuation work on a large scale.
>
> "The sales method may be defined as a plan or process for the systematic collection and comparison of data relating to real-estate transfers for the purpose of estimating true market realty values. It consists in a study of the transfers of neighboring property having conditions or characteristics similar to the land whose value is to be determined, and is intended to duplicate, as nearly as may be, the mental or judicial processes ordinarily employed by the so-called 'local real-estate expert,' with a view to arriving at results approximating those which would be reached by such local expert acting without bias or suggestion.
>
> "The sales method is capable of application in a variety of ways, in fact, is as flexible in its possible applications as are the varied methods employed by individual local experts. Two interpretations of the sales method have been most commonly employed. In one of these the area and consideration in each sale of similarly situated land is found, and the average unit price—per square foot, per foot frontage, per lot, per acre, etc.—ascertained, and this unit applied to the tract under investigation.
>
> "The other application of the method introduces what, in many cases, is believed to be an additional safeguard, consisting of the use of the average assessed value of adjacent or similarly situated lands in combination with an average ratio or percentage representing the relationship of the assessed value of transferred lands to the total consideration paid for such transferred lands in the district or locality under consideration, all of these figures being based on the 'ground values' exclusive of the improvements thereon.
>
> "Such use of assessment figures is designed to introduce, as far as may be, the results of the judicial processes of the assessor, who, at least in theory, serves on behalf of the public as an unbiased expert in the matter of relative valuations, and who attempts to make allowance for the peculiar attributes or characteristics of individual parcels of real estate in any given locality or neighborhood of a city.
>
> "In the broader and more flexible applications of the sales method, the expert adopts one or the other of the processes just outlined, or blends the two together in such fashion as to yield the most consistent and trustworthy final result. In the process of valuing a tract of land involving conflicting data, as in the case under consideration, the

expert user of the sales method on this flexible basis derives a series of tentative results similar to the results representing the judgments of individual local experts.

"The judicial function involved in the discriminating selection of data and in the derivation of final results is exercised along essentially parallel lines with the two classes of experts here compared. The further act of the judgment in selecting a final preferred valuation figure in the light of a group of preliminary or tentative results is identical in the two cases.

"In the particular valuations here considered, the similarity of the basis is further emphasized by the fact that the results by the sales method represent the composite judgment of four members of the Commission's expert staff, as against an equal number of local real-estate experts employed by the company. . . . ."

Building Appraisement.

Given the inventory data specified in the article on inventory methods (see Electrical Review for August 9) and a complete set of floor plans, the appraisement of the buildings occupied by an electric utility company is an exceedingly simple problem. There are several ways in which such an appraisement may be effected. The buildings may be appraised by making a detailed estimate of the cost of all materials entering into their construction; they may be appraised by computing the total number of cubic feet of contents and applying a unit cost per cubic foot, or they may be appraised by determining the number of square feet of floor area and applying a unit cost per square foot.

It is probable that the first mentioned method is the best—that of estimating, with a considerable degree of detail, the amounts of the various kinds of materials entering into the building construction; estimating the cost thereof, and of the attendant labor necessary to erect the building. However, this method is somewhat laborious and it is thought that accurate results may be obtained, by specially experienced building appraisers, with the aid of simpler methods.

Knowing the type of construction—and most central-station buildings may be divided into a half dozen or more standard classifications—it is a comparatively simple matter to determine a unit cost per cubic foot of contents which may be used in the building appraisement. The use of this method, however, should only be attempted by one thoroughly versed in the appraisement of central-station buildings. Great care should be exercised to see that the unit costs are representative ones—especially in these times of high material prices and high wage rates. All unit costs derived upon the volume basis (cubic foot of contents, cubic yard of concrete foundation, etc.) should be carefully checked before they are used. If a building is appraised by the cubic foot method special attention and special treatment should be given to such items as stack, stack foundation, building foundations, piers, excavation, back-filling, etc.

There is still another point which should be most carefully investigated. Most central stations, whether hydraulic or steam, are located near a waterway. It frequently happens that quicksand is encountered in excavating for foundations. This, of course, appreciably increases the cost of the building foundations and provision for such a contingency should be made in deriving the unit cost used in appraising the building. The writer recently appraised a plant in South Dakota, where the central-station building was located a few feet from a stream. It was found that the brick stack cost the company $2500. Under ordinary conditions the concrete foundation for this stack should not have cost over $500 or $600. Something in the soil conditions near the central station made the appraiser suspicious of sub-surface quicksand. After a good deal of trouble the appraiser interviewed the contractor who built the stack and found that his suspicions were well founded. As a matter of fact the actual cost of the concrete foundation—including shoring, piling, pumping, extra concrete reinforcement, etc., amounted to nearly as much as the cost of the stack itself—over $2000.

In view of the fact that, in the case under discussion, the central station was located at the only logical site for a power house, the additional cost of building on quicksand could not be avoided. An allowance, therefore, for this cost was included in the reproduction cost of the power plant. As the foregoing illustration will indicate, it is most important that an investigation be made of the construction history of a central-station building in order to provide, insofar as possible, for such unusual contingencies.

A Practical Method of Building Appraisement.—The following method has been used by the writer in appraising the central-station buildings of electric utility companies.

Assume the case of a brick and concrete building—brick walls with concrete foundations. Assume further that the concrete foundations extend about four feet above the level of the ground. Measure the length and width of the building. Determine the average thickness of the concrete foundation wall and estimate, as closely as possible, the distance the foundations extend below the ground. Knowing the average thickness of the wall and its height (below and above ground) the cross-sectional area in square feet may be determined. Multiply the result by twice the length plus twice the width (in feet) of the building; this will give the total number of cubic feet of concrete in the foundation wall. Make a deduction for door and window openings and reduce the figure above obtained to cubic yards. Apply a unit cost per cubic yard which will include the cost of material, cost of mixing concrete and cost of placing.

Determine the average height of the building above the foundation wall, multiply the figure thus obtained by the length in feet and the result by the width of the building in feet. The result will be the displacement of the building, expressed in cubic feet. Apply a unit cost per cubic foot—this unit cost being weighted to correspond with the type of building under appraisement. It is assumed that the appraiser has a large amount of data available upon which to draw and from which he can select a suitable unit cost. Buildings with different types of roofs and different types of structural steel construction will have correspondingly different unit costs.

Estimate the number of cubic yards of concrete in the stack foundation and apply a suitable unit cost to cover the foundation in place, including material cost, cost of mixing and placing concrete. In this connection it is most important, as heretofore suggested, that the sub-surface soil conditions shall be determined and adequate allowance made in the unit cost for unusual conditions.

If the stack is of brick, determine the height and the average diameter. Build up a unit cost per linear foot of height and apply this unit cost to the total height in feet.

If the stack is of metal, determine the height, diameter and the gauge of the metal. Determine the cost of the material, estimate the cost of riveting and estimate the cost of placing. Stacks of this nature

will usually be delivered in cylindrical sections ready for assembly and erection. Provision in the total cost should be made for freight and cartage charges.

There are firms who make a business of building stacks and it is well to obtain all possible cost data from these firms and, where possible, to have them check the cost as determined by the appraiser.

The Pole Line Appraisement.

In the final recapitulation of the inventory of the pole lines, all of the items of inventory are divided into groups according to their individual characteristics. Poles are grouped according to height and top diameter; anchors according to size and type (patent anchors are separated from log anchors); guys according to size of strand and average length; crossarms according to length in feet and cross-sectional area in inches, etc. The next step in the appraisement is, therefore, the derivation of a suitable unit cost for each inventory group.

TABLE 1.—MATERIAL PRICES* FOR WESTERN AND NORTHERN CEDAR POLES.

Height (feet).	Top (ins.).	Quotation, 8-28-14, f. o. b. Indianapolis.	Quotation, 12-16-14, f. o. b. Kokomo.	Quotation, 6-28-15, f. o. b. De Kalb.	Aver'ge, 8-28-14, 12-16-14, 6-28-15	Quotation, 10-24-16, f. o. b. Decatur.
30	5	$3.40	$3.40	$3.10	$3.30	$3.35
	6	4.05	4.05	3.70	3.93	4.75
	7	5.70	5.70	5.50	5.63	5.95
	8	6.40	....	6.30	6.25	7.00
	9	10.25	....	10.45	10.35	10.80
35	5	....	5.00	5.05	5.03	4.75[1]
	6	6.70	6.70	6.25	6.55	6.20[1]
	7	8.90	8.90	9.05	8.95	7.00[1]
	8	10.25	10.25	10.45	10.32	8.70[1]
	9	13.15	.....	.....	13.15	9.90[1]
40[1]	6	.....	.....	.....	7.92	8.55
	7	8.15	.....	.....	8.15	8.80
	8	9.55	.....	.....	9.55	9.90
	9	.....	.....	.....	11.50	12.00
45[1]	6	.....	.....	.....	10.55	11.00
	7	10.95	.....	.....	10.95	11.56
	8	12.25	.....	.....	12.25	12.75
50[1]	7	13.25	.....	.....	13.25	13.55
	8	14.40	.....	.....	14.40	14.80
	9	.....	.....	.....	16.64	17.10
55[1]	8	16.80	.....	.....	16.80	.....
60[1]	7	.....	.....	.....	17.03	17.50
	8	.....	.....	.....	18.88	19.40
	9	.....	.....	.....	22.39	23.00

*Note that these prices are obsolete and are used for illustrative purposes only.
[1]Western or red cedar.

Unit costs applicable to the various classifications of poles are usually built up simultaneously, one study being made of material costs and another of labor costs. In determining the material costs, prices are obtained not only as of the date of appraisement but also for the several years preceding the appraisal. Table 1 presents the results of the pole-cost study made in connection with an actual appraisal. In this connection it should be noted that the appraisement under consideration was made some time ago and the prices, of course, are useless today. Prices as used in this series of articles are merely for illustrative purposes and should not be used in actual appraisal work. It is most unwise to quote prices in technical articles, or in books on the subject of appraisement, except for illustrative purposes. Prices vary so rapidly that there is always danger of misleading the reader.

In the first column of Table 1 the height of pole (in feet) is given; in the second column the top diameter (in inches) and in the last five columns quotations, over a two-year period, f. o. b. various points in the vicinity of the plant under appraisement. It will be noted in this particular case it was not necessary to examine prices over a five-year period. The reason for this will be apparent from the date of the price quotations. Prior to 1914 there was little change in pole prices for several years. The appraisal from which this illustration was taken was made in the latter part of 1916. Hence, the analysis of prices over a two-year period was sufficient. It proved the fairness of the unit costs used in the appraisement.

The next step in the derivation of the pole unit costs involves the determination of proper labor costs. Table 2 presents a rather complete analysis of the labor costs entering into the preparation and erection of electric light poles. The various operations are listed in the left-hand column (for pole sizes of from 25 to 35 ft., inclusive) and the corresponding costs for different diameters of poles are entered in the last six columns.

It will be noted that the item "supervision" is included in Table 2. Supervision, in this case, is limited to the direct supervision of the gang foreman, only the salary and expenses of the gang foreman and that portion of the salary and expenses of the supervising foreman which may be allocated to pole-construction work being included in the unit cost. The cost of general supervision—the supervision of general officers—falls under the collateral construction costs and will be discussed in a subsequent article.

Before preparing a study of the nature of the one illustrated in Table 2 it is necessary to ascertain the labor wage rates prevalent in the community in which the plant under appraisement is located and also to see that the labor rates used as a basis for the labor unit costs are not too high or too low, in other words, that they represent fair average prices for the four or five years antedating the appraisal.

Table 3 is in the nature of a summary of the studies presented in Tables 1 and 2. Fair pole prices, as determined from Table 1, are shown in the third column. In the fourth column it will be noticed an allowance of 2% of the cost of the pole is added for waste and loss. Such an allowance is customary in deriving unit costs for materials used in outside plant construction. The reason will be obvious when it is remembered that no matter how carefully materials may be handled, a certain percentage will be broken or lost. Naturally the amounts represented by this percentage will not be found in taking an inventory of the plant, but nevertheless the material was paid for at the time of the plant's construction. In the case of the poles the allowance of 2% is to compensate for poles that are broken in handling. A 2% allowance for waste and loss is used in the derivation of practically all of the unit costs for outside plant con-

TABLE 2.—LABOR COSTS OF CEDAR POLES IN CITY, EXCLUSIVE OF PAINTING, STEPPING, SHAVING AND GAINING.

	Inches—					
	5	5½	6	6½	7	8
25-foot—						
Unloading	$0.109	$0.123	$0.138	$0.153	$0.170	$0.206
Roofing	.032	.036	.041	.046	.050	.061
Hauling	.272	.309	.346	.381	.425	.515
Digging	.454	.516	.578	.644	.710	.860
Setting	.301	.343	.382	.426	.470	.569
Supervision, 15%	.175	.199	.223	.248	.274	.332
Total	$1.343	$1.526	$1.708	$1.898	$2.100	$2.543
30-foot—						
Unloading	$0.149	$0.168	$0.190	$0.210	$0.230	$0.275
Roofing	.036	.040	.045	.050	.055	.066
Hauling	.356	.403	.453	.500	.550	.659
Digging	.577	.655	.733	.812	.890	1.066
Setting	.402	457	.511	.566	.620	.742
Supervision, 15%	.228	.258	.290	.321	.352	.421
Total	$1.748	$1.981	$2.222	$2.459	$2.697	$3.229
35-foot—						
Unloading	$0.200	$0.226	$0.250	$0.274	$0.300	$0.352
Roofing	.040	.045	.050	.055	.060	.066
Hauling	.466	.525	.585	.642	.700	.776
Digging	.716	.809	.902	.991	1.080	1.196
Setting	.534	.601	.668	.734	.800	.886
Supervision, 15%	293	.331	.368	.405	.441	.491
Total	$2.249	$2.537	$2.823	$3.102	$3.381	$3.766

struction. This percentage has been determined from observation of a large number of actual construction jobs.

The fifth column of Table 3 is determined by adding the respective figures in columns three and four, in other words, it presents the total material and its costs. The sixth column (labor cost) is taken from Table 2, and the last column presents the complete unit costs.

The unit costs as derived in Table 3 are exclusive of painting and stepping. Where the poles are painted or stepped or both, it is necessary to derive additional unit costs. The derivation of such unit costs is illustrated in Tables 4 and 5. The method will be obvious and it is thought that no explanation is necessary.

Unit Costs for Pole Attributes.—In addition to the poles themselves placed, painted and set, there are several items that must be considered in connection with the appraisement of the pole plant—the pole attributes, as they have been aptly termed by one of the large midwestern companies. The pole attributes consist of crossarms, anchors and guys. Illustrative examples will be given showing the method of deriving the unit costs used in the appraisement of the pole attributes. These illustrations, together with a brief description, should suffice to show the reader how this phase of the work is handled.

Crossarm Unit Costs.—In deriving the unit costs used in the appraisement of the crossarms, it is first necessary to tabulate all data pertaining to crossarm prices for a period of several years antedating the appraisal, in much the same manner as that suggested for the pole plant and illustrated in Table 1. In a similar manner a representative wage-rate schedule must be used in computing the labor costs. Having determined the material and labor costs on a satisfactory basis, the appraisal engineer will then proceed to build up a unit cost per crossarm installed in the manner illustrated in Table 6. It will be noted that a complete bill of material is given (priced out at average material prices) and, after the total material cost is obtained, there is added an allowance for waste and loss and a labor cost for placing the crossarms. The unit labor cost of placing the crossarms is derived by estimating the daily cost of a gang necessary for placing crossarms and determining as accurately as possible the number of crossarms that such a gang would place ordinarily in one day; the total cost per day divided by the number of arms placed a day will give the unit labor cost. The time element (number of arms placed per day) is a most important one and may only be properly determined from extensive data showing the results of actual performances.

Cost of Anchors and Guys.—A similar method is adopted for determining the unit costs used in the appraisement of the anchors and guys. Table 7 illustrates the method of building up the unit cost for anchors and Table 8 that of building up the unit cost for headguys.

We have now completed a consideration of the method of appraisement of the land, buildings and pole-line equipment of an electric utility company. It may be well to again caution the reader that all costs used in the examples are merely for illustrative purposes and should not be used in appraisal work. The practice of prescribing appraisal costs in technical articles and in books on the subject of valuation is an exceedingly dangerous one. Prices change rapidly and, furthermore, prices that are suitable for use in one locality may not be in another, due to differences in freight rates or to some local condition. In every appraisement the unit cost problem should be carefully analyzed by an expert. No attempt should be made to use costs merely because they have been used in some other appraisal, or because they have been quoted in a technical journal.

The next article in this series will deal with the derivation of the unit costs for, and the appraisement of, the remaining items of outside plant—the conduit system, the underground wire and cable, the aerial wire and cable and the transformers. The question of inventory and appraisement of the items "Tools and Supplies" will also be discussed. The appraisement of the central-station equipment will be made the subject of a separate article in which there will be incorporated, in addition to the description of standard appraisal methods, a synopsis of "short-cut" methods which may be used for rough-and-ready ap-

TABLE 3.—SUMMARY OF MATERIAL AND LABOR COSTS FOR CEDAR POLES.

Height (feet).	Top (Ins.)	Pole cost.	2% waste and loss.	Total material.	Total labor.	Cost each.
25	5	$1.08	$0.02	$1.10	$1.40	$2.50
	6	2.10	.04	2.14	1.78	3.92
	7	3.03	.06	3.09	2.19	5.28
	8	3.90	.08	3.98	2.65	6.63
30	5	3.30	.07	3.37	1.83	5.20
	6	3.93	.08	4.01	2.33	6.34
	7	5.63	.11	5.74	2.82	8.56
	8	6.35	.13	6.48	3.38	9.86
35	5	5.03	.10	5.13	2.38	7.51
	6	6.55	.13	6.68	2.98	9.66
	7	8.95	.18	9.13	3.57	12.70
	8	10.32	.21	10.53	3.95	14.48
40[1]	6	7.92	.16	8.08	3.68	11.76
	7	8.15	.16	8.31	4.41	12.72
	8	9.55	.19	9.74	5.14	14.88
45[1]	7	10.95	.22	11.17	5.36	16.53
	8	12.25	.25	12.50	6.29	18.79
50[1]	7	13.25	.27	13.52	6.41	19.93
	8	14.40	.29	14.69	7.51	22.20
55[1]	8	16.80	.34	17.14	8.73	25.87
60[1]	8	18.88	.38	19.26	10.11	29.37

[1]Western cedar.

TABLE 4.—COST OF PAINTING POLES.

Size (feet).	Material.	Labor.	Total cost.
20	$0.23	$0.19	$0.42
25	.35	.22	.57
30	.49	.24	.73
35	.57	.30	.87
40	.65	.37	1.02
45	.74	.45	1.19
50	.84	.53	1.37
55	.96	.62	1.58
60	1.07	.70	1.77

TABLE 5.—COST OF STEPPING POLES.

(Galvanized iron steps, $0.026 each; wood steps, $0.0083 each.)

Height of pole (ft.)	30	35	40	45	50	55	60
No. of iron steps	11	14	17	20	23	26	29
No. of wood steps	5	5	5	5	5	5	5
Material:							
Iron steps	$0.286	$0.364	$0.442	$0.520	$0.598	$0.676	$0.754
Wood steps	.042	.042	.042	.042	.042	.042	.042
Nails for wood steps	.020	.020	.020	.020	.020	.020	.020
Waste and breakage	.007	.009	.010	.011	.013	.015	.016
Total material	$0.355	$0.435	$0.514	$0.593	$0.673	$0.753	$0.832
Labor:							
Boring for steps	0.11	$0.14	$0.20	$0.28	$0.37	$0.48	$0.60
Attaching steps	.12	.15	.18	.21	.24	.27	.30
Supervision, 15%	.03	.04	.06	.07	.09	.11	.14
Total labor	$0.26	$0.33	$0.44	$0.56	$0.70	$0.86	$1.04
Total cost	$0.615	$0.765	$0.954	$1.153	$1.373	$1.613	$1.872

TABLE 6.—ILLUSTRATIVE OF METHOD OF DERIVING CROSSARM COSTS.

1 ten-pin standard 120-in. fir crossarm at $0.63	$0.630
10 1¼-in. by 8-in. locust pins at $0.0123	.123
2 16-d. nails at $0.0001	.001
2 22-in. crossarm braces at $0.051	.102
2 ⅜-in. by 4-in. carriage bolts at $0.015	.030
1 ½-in. by 4-in. fetter-drive screw at $0.025	.025
2 1¼-in. washers at $0.003	.006
1 ⅝-in. by 12-in. machine bolt at $0.077	.077
2 2¼-in. washers at $0.013	.026
Total material	$1.020
Waste and loss at 2%	.020
Total material, including waste and loss	$1.040
Cost of placing crossarm	.498
Unit cost	$1.54

praisal of the central-station equipment. A knowledge of such short methods is frequently an asset to the central-station manager.

The author will be very glad to answer any questions regarding this article, or any of the preceding articles, if addressed to him in care of L. V. Estes Incorporated, 202 South State street, Chicago, Ill.

TABLE 7.—UNIT COST OF LIGHT PATENT ANCHOR.

1 patent anchor, 5-in., at $0.850	$0.850
2 guy hooks at $0.059	.118
1 Crosby clip at $0.155	.155
1 2-bolt clamp at $0.176	.176
10 pole shims at $0.023	.230
1 ⅜-in. thimble at $0.0345	.035
2 fetter drive screws, ½-in. by 4-in., at $0.025	.050
20-ft. ⅝-in. S. & M. strand at $0.011	.220
20-ft. No. 6 B. B. iron wire at $0.0039	.078
Total	$1.912
Add 2% loss and waste	.038
Total material	$1.950
Labor, placing rod	$1.250
Labor, placing guy	1.000
Field supervision and teaming	.338
Total labor	$2.588
Unit cost	$4.54

TABLE 8.—UNIT COST OF HEADGUY.

75-ft. 5/16-in. S. & M. strand at $0.0132	$0.990
50-ft. ⅜-in. S. & M. strand at $0.011	.550
2 guy hooks at $0.0590	.113
2 fetter-drive screws, ½-in. by 4-in., at $0.025	.050
10 pole shims at $0.023	.230
2 Crosby clips at $0.155	.310
2 2-bolt clamps at $0.176	.352
Total	$2.600
Add 2% loss and waste	.052
Total material	$2.652
Labor, placing guy	$2.500
Field supervision and teaming	.300
Total labor	$2.800
Unit cost	$5.45

PRIVATE OWNERSHIP SUPERIORITY DEMONSTRATED IN WORLD WAR.

E. N. Hurley, Former Shipping Board Head, Says Lesson Taught Is to Be One of Greatest Benefit to Country.

E. N. Hurley, formerly chairman of the United States Shipping Board, who has resigned after serving throughout the war, was asked if he would tell, as a sort of valedictory to the American people, what in his job had impressed him most. Mr. Hurley's opinion is valuable in that he knows both phases of industry, having risen from a railroad fireman to the head of one of the largest machinery concerns in Chicago.

"The efficiency of private ownership and operation as compared with public ownership and operation," was the answer, "and I believe this lesson, as it is brought home more emphatically to the American people, is to prove one of the greatest benefits we derived from the war.

"As new facts about the conduct of the war come out, as our experience in many fields of production is appraised, they will point, I predict, more unerringly to this same conclusion—the superior efficiency of private ownership. *All production centers on the cost*—you can't get away from that. Shift responsibility for the cost, for the best possible result under a given set of circumstances, and you shift the responsibility for efficiency. That is what we did on the Shipping Board, under the pressure of war's necessity, when the question of cost was forced into second place. We shifted the responsibility of the cost from private shipbuilding concerns to the Government.

"With the shifting of responsibility of cost to the Government, that keen interest in results which follows private initiative was gone. There you have the whole problem as between public ownership and private ownership stated. No way has been found to instill in public ownership the incentive that possesses private ownership to improve conditions of production.

"The cost-plus-percentage system was a great mistake, and from the start had a bad effect on the workmen and the management. No private concerns could have operated and paid their way on the wages paid under that system. On the basis of cost they could not have borrowed money from the banks. The whole proposition of government ownership is fine in theory; in practice the push of individual energy is missing.

"I don't know of a government-owned plant that produces more than two-thirds efficiency. When the manager has no dividend to strive for when the toll is paid, the slowing up is sure to follow. In the years to come some way may be found to keep incentive to best endeavor in men under government ownership, but until that is discovered that system may be classed as a failure."

ANOTHER MARITIME APPLICATION OF ELECTRICITY DEVELOPED.

Earl C. Hanson Devises Practical Method of Guiding Ships in Harbors by Electricity.

If a new electrical device now being perfected meets with expectations, much delay in ocean travel due to weather conditions will be eliminated in the near future. This has already been accomplished to a certain degree by the development of the radio compass. The new device, however, carries the electrical guiding idea further by enabling a vessel to enter and leave a harbor in all sorts of weather with comparative safety.

It was invented by Earl C. Hanson, of Los Angeles, Cal., and has already been turned over to the Navy Department where it will be put into practical application as soon as all its details are perfected. Tests are to be made at once at the naval base at New London, Conn., and later it is intended to give it a further trial in Ambrose channel in New York harbor using some of the large ocean liners for the test.

The device and the methods of application are comparatively simple. A suitable cable is laid in the ship channel through which is sent a low-frequency electric current. The current in this cable actuates devices on the ship which in turn set up a peculiar sound. This sound indicates when the vessel is directly over the cable. Any variation in the course away from the cable is indicated by visible indicators that show in feet the distance away from the cable. Several of the indicators and sounding devices may be located in the various parts of the ship.

By following these indications the ship can follow the cable line from the harbor line to the dock. Two such cables will be installed, one for ships entering the harbor and the other for those going out. The sound on each cable is different and there can be no confusion which greatly lessens the possibilities of a collision.

Along the cable at certain intervals a short section is insulated with lead. Through such sections no sound can come and therefore the man on listening duty can tell instantly how far the ship has progressed and by referring to the cable chart ascertain where the cable turns and dangerous places are and in which direction the ship must be steered to follow the channel.

Central-Station Rates in Theory and Practice

Tenth Article—Continuation of the Mathematical Analysis of Price Splitting When Value-of-Service Principle Is Followed—Conditions Under Which Price Reductions Are Desirable as Regards Earnings

By H. E. EISENMENGER

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This is the tenth article of this series. A general outline of the entire series appeared in the July 5 issue and the first of the articles in the July 12 issue. The first seven articles discussed the cost of electric service, which must be taken into account in any system of rates. In the last two articles a comparison has been made of the cost-of-service and value-of-service policies in rate making, it being shown that the latter permits an extension of the service to such groups of customers as could not be reached if a uniform percentage of profit were expected from all groups. The conditions under which price reductions are possible without curtailed earnings are studied mathematically in Insert IX, which will be concluded next week, and then the main text will be resumed for practically the remainder of the volume.

PART II—THE PRICE OF ELECTRIC SERVICE—Continued.

Insert IX—Appendix to Section 80 et Seq.—Relations Between Selling Prices and Earnings—Continued.

II. PRICES DEPENDING ON THE CUSTOMER'S VALUATION (VALUE-OF-SERVICE PRINCIPLE).

A. EVERY PARTICLE OF THE SERVICE IS CHARGED IN ACCORDANCE WITH ITS VALUATION.

SECTION 7. We change over now from the cost-of-service principle to the value-of-service principle in such a way that, starting with the unit price p, we add one or more other prices *lower than* p, for instance first the unit price p_1, in such a manner that this lower price applies to those parts of the commodity (service) *only* for which the respective customers are not able or willing to pay the original price p, whereas we continue to charge the original price p for all those parts of the commodity which had been sold heretofore under the original system of charging. We will in practice, of course, not be able to fulfill this theoretical requirement entirely, but there are several ways of approaching it with a reasonable degree of accuracy (see Sections 94-102 of the main text and Section 14 of this Insert).

This operation of applying two or more different prices to the same commodity according to the valuation by the purchaser will be called *"price splitting"* and the prices formed in this manner will be called *"conjugated prices"* or a *"price combination."* If the prices split off in this manner are all lower than the original price (as has been assumed so far), the operation will be called *"price splitting downwards"* and the prices split off are *"lower conjugated prices."* If prices are added higher than the original price p in such a manner that they apply only for such parts of the commodity for which the customers would be ready to pay these higher prices instead of the original lower price, the operation is called *"price splitting upwards."* Price splitting upwards and downwards can be combined with each other.

8. As a result of the splitting of the prices we will sell the same total amount of the commodity as if we would offer every unit at the lower unit price p_1, that is, we will sell the quantity m_1, which is greater than m. The gross income b_c of the price combination is composed of two parts: (1) The gross income mp of the original customers who are charged the original price p and therefore buy the original quantity m and (2) the gross income of the new customers who buy the balance, that is $m_1 - m$ at the price p_1, therefore

$$b_c = mp + (m_1 - m)p_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$(m_1 - m)\,p_1$ is given by the rectangle MM_1L_1L' and b_c is therefore represented by the shaded area in Fig. A.* No matter how small the lower conjugated price p_1 is, it will always increase the gross income.[1]

9. The total cost of production is determined only by the quantity sold (produced) and not by the prices at which the commodity is being sold. The total cost under the combination of prices is therefore $M_1T_1 = P_1S_1 = s_1$, just as if the whole commodity were offered for sale uniformly at the lower price p_1. Likewise the capital will be $M_1J_1 = P_1K_1 = k_1$.

If the price combination applies, we will therefore have the net income given by

$$n_c = b_c - s_1 = mp + (m_1 - m)p_1 - s_1 \quad \ldots\ldots\ldots\ldots (5)$$

and the dividend (interest)

$$v_c = \frac{n_c}{k_1} = \frac{b_c - s_1}{k_1} \quad \ldots\ldots\ldots\ldots (6)$$

10. The question with which we have to deal here is the following: When is it possible to add one or more conjugated *lower* prices to the original price p in such a manner that the "earnings" (that is, the gross income b_c, the net income n_c, or the interest v_c, respectively, as the case may be) are *increased* over the original earnings b, n and v?[2]

11. As regards the gross income b we have seen from equation (4) of this Insert that it is always possible to increase it by price splitting downwards, no matter how large or small the original price p or the conjugated lower price p_1 is. There are no lower or upper limits for the prices.

12. As regards the net income we find the following: The original net income is given by

$$n = b - s = mp - s \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Subtracting this equation from equation (5) we get

$$n_c - n = (m_1 - m)p_1 - (s_1 - s)$$

Using the symbol Δ for differences in the customary way so that $\Delta m = m_1 - m$ (positive value) and $\Delta s = s_1 - s$ (also positive value) and $\Delta n = n_c - n$ (to be investigated whether positive or negative value) we can write the above equation in the following form:

$$\Delta n = p_1 \Delta m - \Delta s$$

Δn will be >0, that is n_c will be $> n$, if $p_1 > \frac{\Delta s}{\Delta m}$.

This means, the net income is necessarily increased by the addition of a lower conjugated price in all cases where that price is higher than the cost increment per unit.[3] Now the original price from which the lower conjugated price has

*See page 389 of last week's issue.

[1] It may be stated here incidentally that we can, of course, add more than one conjugated lower price, in which case the gross income will become greater and the shaded area will contain more than two steps. We can, in fact, add an infinitely large number of conjugated lower prices which will change the shaded area, representing the gross income, into the total area under the sales curve between ordinates given by the highest and lowest prices.

[2] The importance of this problem is based on the following considerations: If it is possible to add the lower prices with the result mentioned, this means that we will be able to increase the earnings by price reductions to some customers without price increases to others. Or with constant earnings we can reduce the prices to all customers as a consequence of the change from the cost-of-service system to the value-of-service system. (See Sections 78 and 88-91 of the main text). The solution of this problem is therefore at the bottom of the question of the superiority of the cost-of-service or the value-of-service system of charging.

[3] See footnote to Section 75 of the main text.

been split off must, of course, according to the definition of a *lower* conjugated price (Section 7 of this Insert) be greater than that lower price. On the other hand, the original price upon which the original cost-of-service system was based must have been greater not only than the cost increment per unit, but even greater than the average cost (see Section 2 of the main text) given by equation (1) of this Insert, otherwise the enterprise would have been a losing one from the outset. We will therefore always be able to add lower conjugated prices which increase the net income. The lower limit of such profitable conjugated prices is the cost increment per unit.

13. As regards the interest (dividend) v we have the original interest v given by

$$v = \frac{n}{k} = \frac{b-s}{k} = \frac{mp-s}{k} \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Subtracting this from equation (6) we get

$$v_e - v = \frac{b_e - s_1}{k_1} - \frac{mp-s}{k}$$

or, substituting the value of b_e from (4),

$$v_e - v = \frac{mp + (m_1 - m)\,p_1 - s_1}{k_1} - \frac{mp-s}{k} \quad \ldots\ldots\ldots (9)$$

Now, again introducing the symbol Δ in the same way as in Section 12 above (also $\Delta k = k_1 - k$), we find from (9) that v_e will be $> v$ if

$$[mp + p_1\Delta m - (s+\Delta s)]k > (mp-s)(k+\Delta k)$$

or if $(p_1\Delta m - \Delta s)k > (mp-s)\Delta k$

$$\text{or if } \frac{p_1\Delta m - \Delta s}{\Delta k} > \frac{mp-s}{k} \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

The fraction on the left-hand side of this relation may be called the "rate of return of the increments" or "interest of the increments," inasmuch as it is the increment net income divided by the increment capital (see Section 27 of this Insert). We can say, therefore, that the interest will always be increased by the addition of a lower conjugated price if the "interest of the increments" is *greater* than the original interest.

It remains to be shown that such a lower conjugated price can be found in all cases which are to be considered in practice. This is proved in the following way:

If we make the lower price just a trifle, a differential, smaller than the original or upper price, that is if Δp becomes dp, and if we then should find that the differential of v *must* be positive for all upper prices which would be considered under the cost-of-service system, that would mean that the adding of lower prices, at least in a certain range below the upper price, *must* increase the interest (rate of return). It will be shown in the following that this is actually the case.

Calling $v_e - v = \Delta v$, we get from equation (9)

$$\Delta v = \frac{mp + (m_1 - m)p_1 - s_1}{k_1} - \frac{mp-s}{k}$$

Substituting now $p_1 - p = -\Delta p$* or $p_1 = p - \Delta p$
and $m_1 - m = \Delta m$
and $s_1 - s = \Delta s$ or $s_1 = s + \Delta s$
and $k_1 - k = \Delta k$ or $k_1 = k + \Delta k$

we get Δv

$$= \frac{mpk + \Delta m(p-\Delta p)k - (s+\Delta s)k - mp(k+\Delta k) + s(k+\Delta k)}{k(k+\Delta k)}$$

$$= \frac{pk\Delta m - k(\Delta m\Delta p + \Delta s) - (mp-s)\Delta k}{k(k+\Delta k)}$$

If we now choose Δp smaller and smaller and let it converge towards dp with a consequent change of the other differences into differentials, magnitudes of the second order will vanish beside those of the first order and we get

$$dv = \frac{pk\,dm - k\,ds - (mp-s)\,dk}{k^2} \quad \ldots\ldots\ldots\ldots (11)$$

If now dv shall be > 0 the numerator of (11) has to be positive or $p(k\,dm - m\,dk)$ has to be $> k\,ds - s\,dk$ or

$$p \text{ has to be}^4 > \frac{k\,ds - s\,dk}{k\,dm - m\,dk} \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

This is the condition for a positive dv, or in other words the condition that there is a certain range of prices in existence within which the conjugation of lower prices raises the rate of return v.

Now, from Fig. A and equation (1) of this Insert we see that the average unit output cost $s/m = \tan\sigma_0$. According to fact No. 3 of Section 1 of this Insert, $\tan\sigma_0$ must continually decrease if m increases (see Fig. A) which means that

$$\frac{d(s/m)}{dm} \text{ is always} < 0$$

$$\text{or } \frac{m\,ds - s\,dm}{m^2} < 0$$

$$\text{or } m\,ds \text{ is always} < s\,dm$$

Multiplying by k and then subtracting $sm\,dk$ from both sides: $m(k\,ds - s\,dk)$ is always $< s(k\,dm - m\,dk)$

We can divide both sides of this relation by $m(k\,dm - m\,dk)$ without reversing the sign of inequality because this product is essentially positive[5] and we arrive in this manner finally at the following relation for s/m:

$$\frac{s}{m} \text{ is always} > \frac{k\,ds - s\,dk}{k\,dm - m\,dk} \quad \ldots\ldots\ldots\ldots\ldots (13)$$

The right sides of (12) and (13) are identical. If therefore $p = s/m$ the condition (12) will be fulfilled and if $p > s/m$ the condition (12) must be all the more fulfilled. As we have seen in Section 12 of this Insert,[6] prices which are fit for a practical system of charges under the cost-of-service principle will always be greater than s/m and therefore there will always exist a certain range below the original price within which the conjugation of lower prices raises the rate of return.

B. THE VALUATION AFFECTS THE PRICES OF GROUPS OF SERVICE ONLY, BUT NOT OF EVERY PARTICLE.

14. The above deductions are based on the assumption that we can charge every particle of the service according to the valuation it meets from the customer, which means, not only are different services charged differently to the same customer, and different customers differently for the same service, but different units of the same service will be charged differently even though they are sold to the same customer (see Section 73 of the main text).

We can, of course, never carry out this assumption strictly in practice. We must group large numbers of units into one class of service or of customers, and then charge the whole class under a uniform rate or rate schedule. We may, for illustration, charge all kilowatt-hours for heating service at the same price and differently from the kilowatt-hours for other classes of service. The same may apply to the kilowatts demand for heating service. Or we may charge the first 500 kw-hr. of wholesale power service at a separate price, etc. We will thus select a certain limited number of unit prices and the problem is to choose these prices at such amounts as produce the maximum of earnings which is possible with the chosen number and distribution of prices. This grouping of the individual units into classes means of course a deviation from the theoretical system of charging, inasmuch as some of the units will be charged at lower prices than they could fetch at the utmost, whereas for others there will be demanded too high a price so that they cannot be sold. Therefore this grouping will reduce the earnings below the earnings of the theoretical system which charges every particle of the service individually.

As the units within each group are charged at the same price, this grouping amounts to resolving the value-of-service system into a number of cost-of-service systems. The relative prices of the various groups are determined according to the value-of-service principle. We have therefore in this *practical value-of-service system* a hybrid between the cost-of-service system and the real value-of-service system.

15. We have now a problem parallel to the problem of Section 10 et seq. of this Insert as follows: Can we increase the "earnings" in this practical system by lowering the prices of one or more of the groups without raising the prices to any

*Note that $p_1 - p$ has a negative value because the lower price p_1 is smaller than p, whereas with the values m, b, s, and k the subscript 1 indicates an increase: $m_1 - m = +\Delta m$, etc., because the amount m, etc., which belongs to the lower price p_1 is greater than the amount which belongs to the original price p.

[4] We could also arrive at the same result by direct differentiation of v, n and b and subsequent substitution of the results, but the above method seems to be both shorter and clearer.

[5] The factor m is obviously always positive and as regards $(k\,dm - m\,dk)$ this can be written as $k^2\frac{d(m/k)}{dm}\,dm$. Now fact No. 4 of Section 1 of this Insert shows that m/k (which is given by $\cot\kappa_0$, see left-hand portion of Fig. A) increases with increasing m so that $\frac{d(m/k)}{dm}$ is essentially positive; dm is also positive because we start with a *reduction* of the price p by the differential dp, which (with reference to the shape of the sales curve Fig. A and fact No. 1 of Section 1 of this Insert) necessitates dm being positive. The product of all these factors is therefore positive.

[6] This can also be seen from equation (7) which shows that the net income (and consequently also the rate of return) is positive as long as $mp > s$, which means as long as $p > s/m$.

other group? To investigate this matter we will start with two groups of service only, called g and G (for instance, electric service for heating purposes only and for all other purposes) and the conclusions drawn from this investigation will then be extended to the case of a subdivision into more than two groups.

Each one of these groups has its own sales curve, M and m, respectively. The total-sales curve M_t is formed by the addition of the ordinates of M and m (see Fig. B). Under the original cost-of-service system both groups are charged the unit price p_o. This results in the sale of M_o units of group G and of m_o units of group g.

We shall now investigate the behavior of the three species of "earnings" (gross income, net income, and rate of return) if we split the prices between the two groups.

1. Gross Income.

a. Shape of the Gross Income Curve.

16. The question is: When can we lower the unit price in any one or both of the two groups, for instance in g, in such a manner that the aggregate gross income is increased thereby? We lower the price in group g from p_o to p_1, thereby

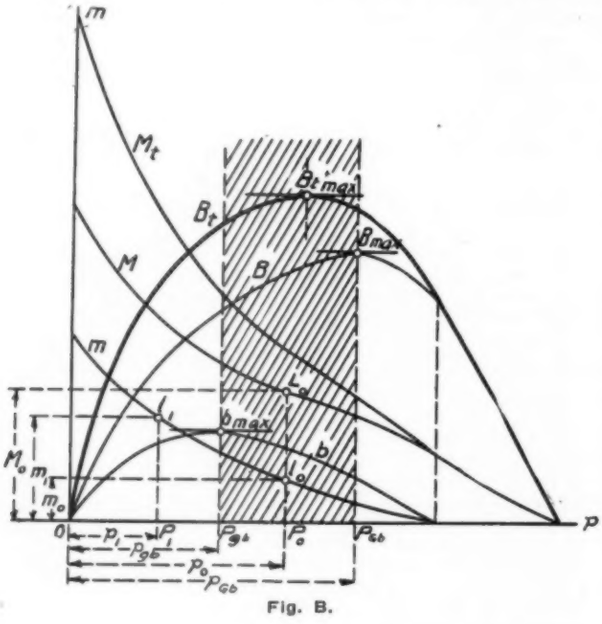


Fig. B.

increasing the number of units sold in that group from m_o to m_1. The original aggregate gross income B_{to}, which is given by $(M_o + m_o)p_o$ changes into $B_{t1} = M_o p_o + m_1 p_1$. If this change shall be an increase, that is, if B_{t1} shall be $> B_{to}$, it follows from the above equations for B_{to} and B_{t1} that

$$m_1 p_1 \text{ has to be} > m_o p_o \quad \ldots\ldots (14)$$

Now $m_1 p_1$ and $m_o p_o$ are the gross incomes from group g alone without any reference to its combination with group G and relation (14) means therefore the following: The necessary and sufficing condition for an increase of the aggregate gross income from the two groups as a result of a price reduction within one of the groups is that the income b from that group alone—group g without regard to the other group G—is *increased* by the price reduction. With reference to Fig. B, which shows the sales curves M and m, the gross income curves B and b, and their summation curves M_t and B_t, we see that this is possible only if the original price p_o is greater than the price $p_{gb} = OP_{gb}$ which produces a maximum of gross income b from that group g alone for which the price is to be reduced; otherwise any price reduction for group g would necessarily result in a reduction of the gross income[7] b. (See Section 2 of this Insert.)

17. This condition means, in other words, that the original price must be high enough so that the corresponding point on the gross income curve b of group g is situated on the descending (right hand) branch of that curve. This wording of the condition is sometimes more convenient for application than that of the preceding paragraph.

18. We can now distinguish the following three cases:

(a) The original price is lower than the lower one of the two respective prices which make the income of one of the two groups a maximum, that is, according to the assumptions made in Fig. B, it is lower than p_{gb}. The original price lies in the range to the left of the shaded range in Fig. B.

(b) The original price is lower than the higher one of the prices which make the incomes of one of the two groups a maximum (p_{Gb}) but higher than the lower one of these prices (p_{gb}). This means it is situated in the shaded range in Fig. B.

(c) The original price is higher than either of the above named prices p_{gb} and p_{Gb}; it lies to the right of the shaded range in Fig. B.

In case (a) any price reduction in any group will always reduce the aggregate gross income.

In case (b) any price reduction in group g to a price not lower than p_{gb} will increase the aggregate gross income, any price reduction in group G will reduce it.

In case (c) any price reduction in group g to a price not lower than p_{gb} and any price reduction in group G to a price not lower than p_{Gb} will result in an increase of the gross income. Although therefore a price reduction in either one of the groups will be of advantage in this case, we will prefer an initial general reduction of all prices, as this is of greater advantage until the price p_{Gb} has been reached which results in the maximum gross income B_{max} of group G alone. After this has been done, this case necessarily reduces to case (b)[8], thus making advisable a further price reduction to one of the groups only.

It may be pointed out here that case (c) will not occur in a well designed cost-of-service system of charging. As the same gross income, and even a greater one, can in this case be obtained with a lower uniform price, case (c) would mean that the price has been chosen too high altogether from the producer's point of view and consequently also from the consumer's point of view. (Compare the closing sentence of Section 5 of this Insert.)

19. Wherever we find that a price reduction in any group is of advantage to the aggregate gross income it is obvious that, in order to obtain the best results which can be obtained by a variation of the prices in the respective group, this price reduction must be continued so long and not longer until we have reached the price which results in a maximum of the gross income of the respective group, for the following reason: If we stop reducing the price earlier there will still exist the possibility of further increasing the gross income by a continued price reduction, because in that case we are still on the descending branch of the income curve[9]. Conversely by pushing the reduction beyond the mentioned point we will come onto the ascending branch of the income curve which shows that an increase of the price would be proper in its place and that we have therefore gone too far with the reduction.

20. Relation (14) can be written

$$\frac{m_1}{m_o} > \frac{p_o}{p_1} \quad \ldots\ldots (15)$$

This means in words: A reduction of the price in a certain group or class of service *must* have the effect of increasing the gross income if the sales curve has such a shape that the number of units sold of that group rises more rapidly than the price is reduced. If, for instance, the price of a certain class of service is reduced to 3/4 of its original amount, the number of units sold would have to rise to more than 4/3 of the original amount; $\frac{p_1}{p_o} = \frac{3}{4}$, $\frac{p_o}{p_1} = \frac{4}{3}$, $\frac{m_1}{m_o} > \frac{4}{3}$.

The above is another way of expressing the law contained in Section 17 of this Insert. If the price corresponds to the descending branch of the income curve the number of units sold at a price in the immediate neighborhood of the original price increases at a more rapid rate than the price reduction indicates, and vice versa. This is demonstrated by relations (14) and (15).

21. It is easy to extend this line of reasoning to more than two groups (and to income curves with more than one

[7] This wording is based on the preliminary assumption that the curve of the gross income has only one maximum.

[8] An exception is the special case when the shapes of all the sales curves should happen to be such that the maxima of the income curves of all groups occur at the same price, in which case $\frac{dB}{dp} = \frac{db}{dp} = \ldots = 0$ for $\frac{dB_t}{dp} = 0$. The width of the range within which price splitting is of advantage becomes zero in this limiting case.

[9] If there should occur more than one maximum of the group's gross income curve in the range of prices below the original price (wavy income curve, see footnote to Section 22 of this Insert) we must obviously push the price down so far and not farther until we have reached the highest one of these maxima, because if we stop reducing earlier, that is, before reaching the maximum or on reaching a maximum which is lower than the highest one, there is still the possibility of increasing the income from that group, according to relation (14) of this Insert, by a price reduction of that group.

maximum). As a result we can express the law laid down in Section 18 of this Insert in different words and with more general validity as follows:

Where it is intended to bring about an increase of the gross income by means of price reductions to one or more groups of service without any price increase to others, this is always possible if the sales curves of these groups have such a shape that a ratio of price reduction can be found which makes the number of units sold in that group or groups rise at a more rapid rate than the rate at which the prices decrease; (if, for instance, at a reduction of the price to one-half its original value, the number of units sold would rise to more than twice their original amount). Whether this means a general reduction of the prices or a splitting off of prices for a certain number of groups only, depends on the number of groups which have the above quality. If they *all* have sales curves of the shape mentioned [Section 18—case (c)] a general lowering is the most efficient means of increasing the income, and according to Section 19 of this Insert, the price of every group will generally be lowered to a different level, which means price splitting downwards. Otherwise [case (b)], the prices will be lowered to some, but not to all, of the groups (again generally to a different level in every group, if the reduction takes place in more than one group.) This again means price splitting downwards.

b. Shape of the Sales Curve.

22. A graphical representation will make the above clearer and at the same time pave the way for the subsequent deductions. If, instead of the relation (14) $m_1 p_1 > m_0 p_0$, which states the condition for an increase of the gross income by price splitting downwards, we write the equation

$$m_1 p_1 = m_0 p_0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (16)$$

this represents the limiting case of relation (14), and consequently also of (15). The graphical expression of this equation is an equilateral hyperbola with the axes of coordinates m and p as asymptotes (Fig. C). If the value of $m = P_0 N_0$, which belongs to p_0, is assumed as variable ($P_0 x_1$, $P_0 x_2$ ..., etc., see Fig. C) a family of such hyperbolas, as indicated by the thin lines in Fig. C, will result. With sales curves having the shape as determined by facts Nos. 1 and 2 (stated at the beginning of this Insert), every sales curve must from left to right intersect higher and higher situated hyperbolas of this family until it just touches one of them from below (dash-and-dot line, point N_t) indicating that the maximum gross income has been reached and then it intersects a second time all the hyperbolas in the reverse order.[10]

Where the sales curve intersects the hyperbola in such a manner that it is lower than the hyperbola to the left of the point of intersection and higher to the right, the gross income curve is therefore in its ascending (left hand) branch, and vice versa. The two points of intersection with the same hyperbola, for instance H_1 and H_2, indicate prices which produce the same income (because mp is constant along the whole course of every hyperbola of the family).

23. From this follows another way of wording the condition that price splitting downwards will increase the gross income. We reduce the ordinates of the sales curve to percentages of the ordinates of the respective curve at the price p_0, choosing, for instance, for all curves the ordinate M_0 of group G at abscissa p_0 as 100%. Thus, for illustration, the sales curve M of group G has been transferred unchanged from Fig. B to Fig. C and the sales curve m of group g has been entered with ordinates increased in proportion so as to reach the percentage $M_0 = 100\%$ at abscissa p_0. Consequently this curve, which has been called $\%m$ in Fig. C, will intersect the sales curve M (which now might also be called $\%M$) at the point N_0 (abscissa p_0). If we have more than two groups, the curves of the remaining groups will be treated like curve m so that the percentage curves of all the groups will pass through point N_0. A hyperbola of the family will of course also pass through the same point N_0 in which all the percentage sales curves intersect. If now at least one of the percentage curves has a greater slope than the hyperbola (in other words, if the hyperbola is not the steepest one of the bundle of curves passing through the point N_0) then it *must* be possible, within a certain range of prices $< p_0$, to improve the gross income by price splitting downwards. The prices are to be lowered for that group (or those groups) which has a greater slope than the hyperbola.

It is also clear, and needs no further explanation *per longum et latum*, how far down the range reaches within which price splitting downwards is of advantage in every group and for which price the maximum of income is reached.

24. The same lines of reasoning as have been applied in the above, beginning with Section 16, for the gross income, can also be applied *mutatis mutandis* to the net income and to the rate of return (dividend) with entirely analogous results. In the following will be shown in what respects the methods and the results of the investigation differ from those for the gross income.

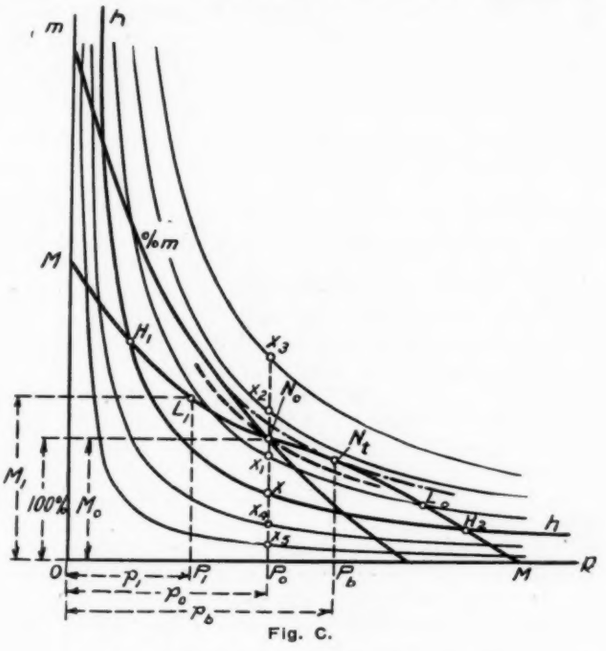


Fig. C.

(To be continued.)

UNITED STATES MAY BECOME WORLD'S CHIEF COAL EXPORTER.

The United States has now moved up from third to second place in the list of coal exporting countries of the world and British newspaper opinion seems to contemplate America's becoming the world's permanent chief coal exporter. According to figures in the London *Times*, reported by the American Chamber of Commerce in London, Britain's coal exports for the twelve months ended June, 1919, were approximately one-half her exports in 1913, the last pre-war year. The figures given are 37,000,000 tons and 73,400,000, respectively. Meanwhile America's exports have increased from 19,000,000 tons in the fiscal year 1914 to nearly 26,000,000 tons in the fiscal year 1918.

Even allowing for the worrisome exodus of foreign labor from the United States and the consequent falling off in coal production, it is estimated that the American output for 1919 will be three times that of Great Britain and four or five times that of any other country. The statement is made that about one-half of America's output is produced by means of machinery whereas only one-fifth of Great Britain's output is thus produced.

[10] We can see from this that if the sales curve has no point of inflection the income curve cannot have more than one maximum, because then obviously the above mentioned point at which the sales curve just touches one of the hyperboles from below, cannot be repeated in the course of the sales curve. As will become clear from the latter part of this Insert (Sections 37-38 and 41-42) this applies not only to the curve of the gross income, but also to those of the net income and of the rate of return. On the other hand, one or more points of inflection in the sales curve do not necessarily mean that the curve of earnings must have more than one maximum.

It also follows that a sales curve with the concave side facing upwards, such as the sales curve in Fig. A, results in a flatter peak of the gross income curve (and of the other earnings curves) than a sales curve with the concave side facing downwards and that the choice of the right price is of greater importance in the latter case. If the sales curve runs along one of the hyperbolas in Fig. C through a certain range of prices the curve of the gross income will be entirely horizontal for that entire range and it will make no difference on the income which price we choose as long as we remain within that range.

Hydroelectric Energy in France

Fuel Supply Being Inadequate, France Must Develop Her Sources of "White Coal" in Order to Meet Industrial Needs —America Can Co-operate in Hydroelectric Development

By C. W. A. VEDITZ

Former American Commercial Attaché at Paris and Madrid

IT IS recognized by most authorities in France that if that country is to become a greater industrial nation she will have to find some substitute for coal as a producer of motive power. In normal times, and more particularly since Alsace and Lorraine have been restored to her, the industrial situation of France is largely explained by two fundamental facts: France has an abundance of iron ore and a shortage of coal. In normal times France consumes about 60,000,000 tons of coal per annum, and her coal mines produce about 40,000,000 tons. (In 1913, the last complete year before the war, the amount was 40,844,000 tons, of which 67% came from mines in the Nord and the Pas-de-Calais—regions invaded by the Germans.) France's imports in 1913 included 18,711,000 tons of coal, 3,070,000 tons of coke, and 1,086,000 tons of fuel agglomerates, such as briquettes, etc. Most of the coal came from Great Britain, most of the coke from Germany, and most of the agglomerates from Belgium.

France, even though she draws more coal from her mines, and notwithstanding the coal output of the annexed territories, will undoubtedly need some substitute for coal to meet not only her future requirements, but also her present requirements. It should be noted particularly that the bulk of the coal produced in France is mined in the northern and northeastern parts of the country, whereas numerous new industrial plants requiring power are established already, or will be hereafter established, in the southeast, the center, and the southwest parts of France, to which places French coal has a "haul" long enough to make it dearer than elsewhere, and in which, therefore, the imported coal is used, especially near port towns. It is also recognized that even after peace is signed, coal, while it may not continue to be as dear as it was during the war, will nevertheless be much dearer than before the war; likewise, it is obvious that labor will be dearer in productive enterprises than it was before the war. On the basis of these facts, the following conclusions may be drawn:

Fuel and Power Conditions Confronting France.

(1) Labor will be dearer and scarcer, and therefore there will be increased incentive to substitute machinery and motive power for labor and human or animal power.

(2) Coal will continue to be insufficient for the needs of the nation as a producer of power, and will probably cost much more than it did before the war. The mines in the region invaded by the Germans have been left in a state deplorable beyond expression: the French chief inspector of mines states that many of them will require from five to ten years to be put into full working order.

(3) The new industrial establishments that will be established, or that will expand their activities, in the southern, western and central parts of the country, where coal is relatively dear, will welcome some other more economical method of producing power.

(4) Attention will have to be turned more largely in the direction of utilizing what the French call "white coal"—hydroelectric energy. The trend in this direction was manifested before the war, and has been emphasized during the war to a noteworthy extent, inasmuch as several newly established plants working for the government in the manufacture of munitions, and especially chemical products and gases, have utilized hydroelectric energy on a comparatively large scale.

The Hydroelectric Power Available.

From the standpoint of utilizing industrially the power of falling water, France is well placed. According to Robert Pinot, general secretary of *Forces Hydrauliques*, the following is the rank of European nations with respect to available hydroelectric power:

Country	Horsepower
Norway	7,500,000
Sweden	6,750,000
Austria-Hungary	6,460,000
France	5,857,000
Italy	5,500,000
Spain	5,000,000
Switzerland	1,500,000
Germany	1,425,000
Great Britain	963,000

These figures, taken apparently in part from the engineer Pacoret, and in part from reports of the German Union of Electricians, have of course been subjected to much discussion. One of the leading French advocates of the use of "white coal," M. Ader, estimated the minimum available power in France as 4,600,000 hp. and the *average* power as 9,200,000 hp. M. de la Brosse, engineer-in-chief and director of the hydroelectric service of the Alps, agrees on 4,600,000 as the minimum realizable power. Others give as a rule higher figures. But, of course, all of them fall short of the 30,000,000 hp. said to be available in the United States.

Comparing the available power with the size of the several countries, France has 6 hp. per acre, Norway 15, Sweden 8, Austria-Hungary 7.5, Spain 4, Switzerland, 4, and Germany 1.2 hp.

The available power is, of course, unevenly distributed throughout the French Republic. Half of the national area has no utilizable waterfalls. M. Ader has estimated that the minimum power or the low-water productivity of the Southern Alps region (the Savoys and the Dauphinate) is 1,000,000 hp.; for the Jura, the Vosges and the so-called Massif Central, 900,000 hp.; and 1,400,000 for the remainder of the country, including the Pyrenees region. According to de la Brosse, the distribution is as follows: 2,300,000 hp. for the Alps and the Pyrenees; 900,000 for the Center and the East; and 1,400,000 for the rest of

the country. There is little doubt now that these figures are too low for the Alps departments of France.

Water Falls Not Yet Extensively Utilized.

If it be remembered that in 1868 and 1869 two paper manufacturers of the province of Dauphiné installed the first plants using water falls for power purposes along modern lines, and that the problem of transporting the power over considerable distances was solved between 1880 and 1900, France has made but little use of her opportunities. In 1911, only 600,000 hp. were produced in all of France, of which total 473,000 are in the Alps, 55,000 in the Pyrenees, and 51,000 in the so-called Massif Central. It is probable that at the present time the total is from 850,000 to 900,000 hp. The figures for 1916 probably represent about one-tenth of the available power, whereas Germany has utilized about one-half of the power utilizable in that country, despite the fact that Germany is a great coal-producing, and even coal-exporting, nation.

According to Prof. Auguste Pawlowski, France spent in 1913 one billion francs ($200,000,000) for hydroelectric industrial establishments, of which 650,000,000 francs ($130,000,000) went into enterprises for the production and transmission of power; and 200,000,000 francs additional have been since that time devoted to hydroelectric industries. Says this authority: "The work is still in its beginnings. All the available power should be realized, and in the quickest time possible, in the interest of the economic uplift of the country, of its social regeneration, and of its wealth; and in order to permit it to conquer the markets of the world. 'White coal' gives us the means for compensating our lack of coal, enables us to obtain electricity at a low price, to lower in many cases our industrial costs of production, and to improve our agriculture. It will become the surest weapon in the economic struggle of after-the-war."

M. Loucheur, former French Minister of War, now Minister of Industrial Reconstruction, and a leading authority on industry and transportation, speaking of the plan for utilizing the Rhone falls at Genissiat, presented by Messrs. Blondel, Harlé and Mahl, stated that it would involve the annual production of 1,300,000,000 kw-hr. As each kilowatt-hour corresponds to 1.2 kilograms (2.64 lb.) of coal, the falls at Genissiat would represent over 1,600,000 tons of coal, or the equal of more than one-third of the output of the coal mines of Lens or Anzin, or more than all of the output of the coal mines of Blanzy, the richest in the interior of France.

Utilizing "White Coal" for Railway and Traction Service.

The most important utilization of French "white coal" would probably be for railway traction. In 1909, according to the statistics of the "Service des Mines," the steam locomotives or those using self-produced power, represented a total of 7,373,000 hp., while traction current did not amount to more than 138,000 hp. Since then, however, a large number of electric tram lines in the larger towns have been substituted for horse cars, and numerous so-called secondary railways and local railway lines have been electrified. In the Alpine region, the tramways of Lyon and Grenoble, the railways of Dauphine and those along the Mediterranean coast are comparatively recent developments.

The tramways of Bayonne, Biarritz, and Pau are propelled by hydroelectric energy, but those of Toulouse, Perpignan and a number of other towns in this southwestern region are still tributary to steam-power establishments. Some local railway systems are operated by hydroelectric power. The big French Midi (Southern) Railway system inaugurated electric traction upon certain sections of its roads, and proposes to electrify 327 kilometers of its lines (203 miles). But at the present time there is hardly as much as 250 kilometers (155 miles) of railways and street tramways utilizing hydroelectric energy in all the south of France.

In the center of France, hydroelectric power operates the tramways of the Haute Vienne region, of Loir-et-Cher, of Puy, of Limoges, and of a few industrial towns like St. Etienne and Roanne. In all, France in 1914, at the outbreak of the war, had used hydroelectric energy for only a fractional part of her local or general railway system and lines.

Opportunity of American Interests to Co-operate in Development.

In conversations which I had from time to time with engineers and with public officials in France interested in hydroelectric developments, the suggestion was repeatedly made that France would welcome the co-operation of American engineers and of American capital in French engineering enterprises. They recognize our achievements in this line and, while they sometimes resent the "Look who's here" attitude of American visitors proud of the industrial and scientific progress we have made in controlling the resources of our vast continent, they now feel that the work of reorganizing industrial France after four years of exhausting war is not the work of France alone, but of the whole of allied civilization. To be sure, our engineering concerns hesitate to "go ahead" upon the basis of uncertain costs of material, of unusually high wages, of political factors of a more or less disconcerting nature. But did we not find it possible to make war under strange and foreign conditions, and do it fairly successfully? Are we less adaptable in the arts of peace than we have proved ourselves to be in the arts of war?

ELECTRICAL MEANS EMPLOYED IN THE ANTI-SUBMARINE CAMPAIGN.

Scientific Adviser to British Admiralty Tells of Developments Following Adoption of New Attitude.

One of the papers read at the Victory meeting of the North East Coast Institution of Engineers and Shipbuilders held at Newcastle-on-Tyne was contributed by Prof. J. C. McLennan, Scientific Adviser to the Admiralty, who took for his subject science and its application to marine problems. He said it was realized in the autumn of 1917 that the submarine problem was one of the most difficult eyer presented to science for solution. It became clear that it was necessary to introduce into service practically a new system of physical science and engineering. It was accordingly decided to broaden the field from which scientific and engineering talent could be drawn and within the British Admiralty a Department of Research and Experiment was set up under the direction of Charles H. Merz. Professor McLennan could not give details of certain of the means and measures adopted in the anti-submarine campaign, but he gave particulars of developments in the following

directions: Listening devices; echo methods; magnetic and electro-magnetic detection; leader gear; invisible signaling; wireless telegraphy and telephony; explosion pressures; sound ranges, and helium.

As a result of investigations in connection with listening devices, great improvements were made in hydrophones. Microphones and magnetophones of exceeding high sensitivity were realized, and after enormous labor, ways and means were devised for standardizing their construction and their functioning. Hydrophones were constructed and put into service which were suitable for use in water of moderate depth, and other types were made which could be used in water of great depth. In one particular type of instrument modifications and attachments were introduced which enabled one to detect with it the direction of bearing of a source of sound with a fair degree of accuracy. But probably the method of determining the direction of a source of sound waves in water which had proved to be the best was founded on the fact that the sound wave was in the same phase at all points of its wave front. Thus, if there were two hydrophones, in themselves non-directional, placed in the path of the incoming sound, they could be used for finding the direction of the origin of the sound if the phase difference between the sounds received could be detected. There were two ways of doing this: the "binaural" method and the "sum and difference" method.

The binaural method depends on the fact that if the sound from one receiver is conveyed to one ear and that from the second to the other ear, the impression is formed that the sound comes from a certain direction and this direction, as interpreted by the sensations experienced, changes as the phase difference is altered. It can be brought to a certain position with respect to the listener (say to the position directly in front) either by rotating the two receivers about an axis, or by introducing an artificial delay in some form of "compensator." This binaural method was the subject of much work on the part of both British and American scientists, and in the anti-submarine campaign it was found to be of very considerable service. In the "sum and difference" method the impulses from the two receivers are united before reaching the ear, the combined effect observed being a maximum when there is no phase difference between the waves and a minimum when the phases are in opposition. The French Navy developed a hydrophone or listening device known as the Walser gear which had been found very efficient.

With most hydrophones and many listening devices, ship's noises and water noises generally seriously interfered with their effective use, and in practice the chasing ship was compelled to stop at intervals and listen when not under way. This meant that in many cases the quarry was lost. This defect was overcome in a measure by towing a directional hydrophone encased in an artificial "fish" behind a chasing ship. By adopting stream-line formation for the towed body and suitably supporting the hydrophone, water noises were fairly well eliminated. Moreover, as the "fish" could be towed at a considerable distance behind the chasing vessel, many of the sounds emitted by the latter did not reach it and others which did arrive were received with weakened intensity. The development of sensitive listening devices of course received a great impetus by the use of thermionic amplifying valves. As it was found possible under certain conditions to render the propulsion of submarines practically silent, it became necessary to look in other directions for fundamental methods of detecting them.

A system of detection which is full of promise involves the use of a beam of sound waves sent out by a chasing ship in a manner analogous to the use of a searchlight. With such beams of sound waves it is possible to sweep the seas, and when an object of sound such as a submarine happens to come within the beam, the sound waves are reflected and echo effects are obtainable. The character of the beam is, of course, determined in large measure by the frequency of the waves constituting it. The method has been employed with great success and promises to be a very helpful agent. The method is obviously applicable to the locating of mine-fields and other obstacles to navigation as well as to submarine chasing.

In regard to magnetic and electromagnetic detection, Professor McLennan said that magnetic detectors usually require the movable system to be poised or pivoted. They can therefore be used as yet with only a moderate degree of satisfaction in towed bodies or in vessels subjected to violent mechanical disturbances. The range at which magnetic effects can be detected is, moreover, comparatively short. As a result of these defects the use of magnetic detection is somewhat circumscribed. Such instruments can, however, be used under certain conditions, and in particular sea area with great effect. In the war very considerable results were actually obtained by their use. The range at which electromagnetic detection can be applied is greater than is possible with magnetic detection, but the method is, however, essentially a short range one, and in many of the forms in which it has been worked out it cannot be used with success at greater distances than about 300 yards or in depths greater than about 100 fathoms.

The Leader gear represents an important application of an electromagnetic effect which was developed during the war. This gear consists of a cable laid on the bottom of the sea along the course of a narrow tortuous channel leading into a harbor or through a mine field. If an alternating electric current be passed through such a cable it is possible by means of delicate devices installed on a ship to obtain either aural or visual indications of the presence of such a cable, and by these indications the ship can be guided in safety in fog or darkness at speeds as high as 20 knots almost with as much precision as a tramcar by a trolley wire over a railway. Experiment has shown that it is a simple matter to apply this method in water of suitable depth for distances as great as 50 miles or longer.

Research has shown that it is possible under certain conditions to utilize polarized light or ultra-violet and infra-red radiations for secret signalling. With the last-mentioned type of radiation, especially valuable results are obtainable over considerable distances, even in the presence of light fogs. Where it is not advisable to use wireless communication between chasing ships, infra-red signalling is of special value.

One of the most remarkable developments which had taken place in the war, said the author, was in the field of wireless telegraphy and telephony. By the use of oscillating thermionic valves especially great progress had been made. It was now possible to hold conversation with ease between a land station or a ship and an airship or seaplane over considerable distances, and by this means observers on aeroplanes or aircraft could also converse with one another. With high power installations it had been demonstrated that wireless telephonic communication could

be maintained on the sea over hundreds of miles. On the directional side of wireless great advances had also been made. If an aeroplane, an airship, or surface ship should send out continuously for a short interval a series of ether waves, these waves could be picked up over long distances by devices installed in a land station, the direction of the source of these ether waves could be ascertained, and in a minute or two the land station could give the observer of the emitting source his bearing within two degrees relative to the land station. With two land stations it was possible to obtain cross bearings, and the latitude and longitude of the sending air or surface ship could be determined with a high degree of accuracy. With directional devices installed on ships it would be possible for two ships whose positions were known to communicate its true position to a ship enveloped in a fog and situated several hundreds of miles away.

In the section dealing with explosion pressures Professor McLennan said that one method of investigating such pressures was suggested by Sir J. J. Thomson and applied by D. A. Keys. It consisted of the employment of the phenomenon long known to scientists that certain crystals become charged with electricity when subjected to pressure. The amount of the charge produced is proportional to the pressure applied to the crystals, so by having a suitable arrangement for measuring this charge and its variation with time, a complete record of the variation of pressure with time is obtained by placing the crystal detector at any given distance from the exploding charge. Since the duration of the wave in passing over the crystal or engulfing a submarine is only a few thousandths of a second and the pressure generated may be of the order of a half a ton or more per square inch, one can readily imagine the difficult nature of the problem in hand. But by making use of the inertia of a beam of cathode ray particles and employing the fact that they carry negative charges and are deflected by electrostatic and magnetic fields, it has been possible to obtain records of the variation of such pressures with the time. The electrons affect a photographic plate, i.e., they leave an impression on the plate when they strike it. This additional fact has made it possible to determine the change in pressure of the wave from the instant the charge is fired and at as small intervals as we please afterwards. Changes which have taken place in 1/100,000 of a second have been recorded by this means.

A LABOR SUBSTITUTE FOR THE WAREHOUSE.

Additional Features of Application of Electric Industrial Trucks and Tractors for Warehouse Use.

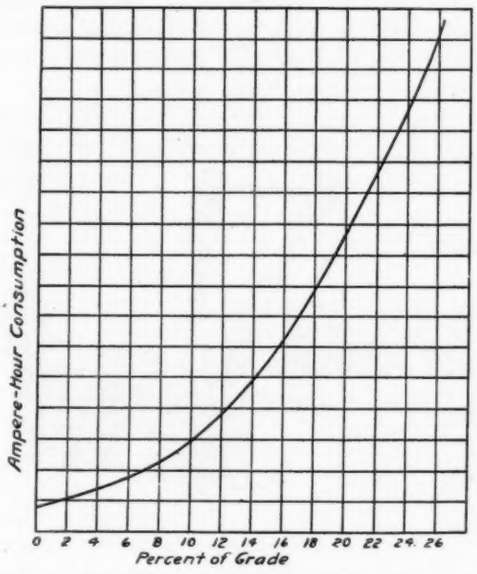
By D. L. Darnell.
The Baker R. & L. Co., Cleveland, Ohio.

During the war, when the army and navy had drawn upon our human resources to such an extent that there were two or even three jobs to every man, every employer wished for the return of the halcyon days when labor was plentiful. It was generally supposed then that peace would dump two or three million men upon the country and that the troubles of the employment man would be at an end.

Today peace is a fact. Except for a few divisions still on the Rhine our armies are back on this side of the water. The men have been discharged and have returned home to take up their old jobs, or better ones. But there is very little change in the labor market. Wages are still away up in the air, and it is next to impossible to find a man who is really experienced at anything.

There have been a number of reasons advanced to explain this condition, and probably the falling off of immigration is the best answer. For five years there has been no immigration at all and now that overseas transportation has been resumed there are few who wish to come—few as compared with the hordes of five years ago. The breaking down of the monarchial system in Europe, fewer men as a result of the ravages of war, more work for those who survived, the hope for a new future—these and many other reasons explain the stoppage of the labor reservoir to which we have looked in the past.

With the labor market in its present condition, and very little hope for improvement, warehouse men are of necessity learning how to do more work with fewer men. Many new labor-saving machines are coming into being and many new uses are being found for old ones. In this latter class comes the electric industrial truck, and even in the past few months numerous new adaptations of this labor-saving machine have been worked out. In fact, there is very little handling work about the average warehouse which these little electrical machines cannot take care of.



Curve Showing Relation of Ampere-Hour Consumption and Percentage Grade for Electric Truck.

The application of a system of industrial transportation to any warehouse installation requires careful consideration of all the conditions and an intimate knowledge of the limitations and possibilities of the various truck models. The industrial truck salesmen must have this knowledge and the ability to quickly analyze conditions and solve for the proper answer. No one has time any more for the man who knocks at the purchasing agent's door and asks, "Are you buying any trucks today?"

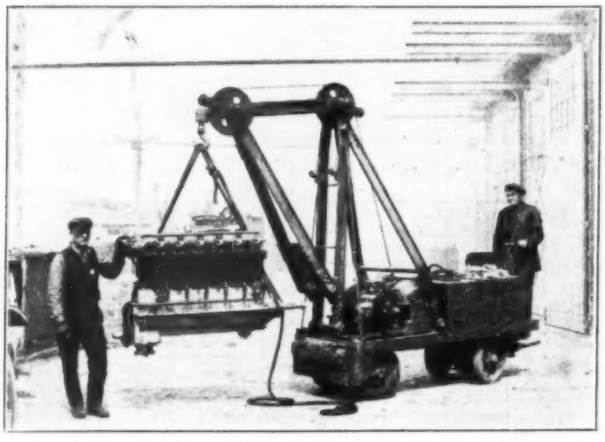
There are two general systems which may be applied to warehouse installations—namely, the tractor and trailers or the load-carrying truck. This latter class embraces the utility truck, the elevating platform truck and the crane trucks.

The tractor and trailer installation seems to be best suited for large terminal warehouses where immense amounts of freight are carried for comparatively long

distances. An installation of this sort will employ from 4 to 10 or more tractors and from 300 to 1,000 trailers. The empty trailers coming out of the inbound freight house or storage warehouse are dropped on the platforms along side of the freight cars to be unloaded. A crew of men at each freight car places the boxes, bales or other freight on the trailers and when there are enough to make a train a tractor comes along and picks them up, whisking them away to be either unloaded into storage space or onto drays for delivery.

In the outbound house a similar set of tractors and trailers carries the freight from the dray shed or the storage warehouse to the cars. The tractor drops its load and goes on to gather up some empties—it is always busy.

In many places it is becoming the practice to rent out portions of the warehouse to different manufacturing firms about the city. Material or supplies are received in carload lots and stored here until required.



Electric Truck Equipped With Crane for Handling Heavy Material.

In such installations the elevating platform type of truck presents a very convenient method of handling. The material is loaded right out of the cars onto wooden skids. The elevating truck picks these skids up and deposits them in the storage space in the warehouse. The material while in storage is kept right on these skids. When the manufacturer is ready to use it the elevating truck places the material still on the skids on the manufacturer's truck; then at the manufacturer's plant another elevating truck carries the material to its ultimate destination. In this way hand labor is absolutely eliminated from the time the material is unloaded from the cars until it is ready to be worked or used.

There has recently been brought out a skid equipped with casters. These live skids are very handy for terminal installations, as such a skid can be loaded right in the box car and then easily pushed out to the platform by hand. Also, in cases where it is necessary to move the skids from one floor to another, the elevating truck can deposit the skids one at a time at the elevator. When the elevator arrives at this particular floor, the operator can easily push three or four skids onto his elevator, take them to the proper floor and push them off again, where another elevating truck will pick them up and carry them to the proper place.

In some warehouses where heavy machines are stored a crane which will pick these up and carry them about is almost a necessity. Such a crane is shown in the accompanying photograph. This crane has a capacity of 3,500 lb. and with its 12-ft. lift can also be used for stacking.

In the foregoing the industrial truck is considered only as a substitute for hand labor, but there is another big point in its favor which is just as important nowadays. The electric industrial truck offers the cheapest, as well as the most efficient, handling method. For the sake of comparison, take the straight load-carrying type truck which is the least efficient of all the types. This truck will handle 4000 lb. at a steady speed of 4½ mi. per hr. It will make the return trip, empty, at 6 mi. per hr. and will not stall and rest in between loads.

Design of Buildings to Prevent Truck Traffic.

In some of the older warehouses conditions exist which prevent the use of electric trucks. Either the aisles are too narrow, or the floors are not in proper shape, or else the elevators have not sufficient capacity. In view of this, the owners must worry along with hand labor and all of its difficulties. So it is important that any firms which are considering building new warehouses should impress upon their architects the necessity of so designing the buildings that the most modern handling systems may be installed.

The most important points to consider are the aisles, the elevators and the ramps. Main aisles should be at least 12 ft. wide and the cross aisles 8 ft. wide. This will give plenty of space of maneuvering the truck and for passing.

Where elevating trucks are used, and it is not intended to move the truck itself from one floor to another, the elevator need only have sufficient capacity to take care of the load. This will depend upon the number of loaded skids which are to be handled at a time. Each skid with its load will weigh in the neighborhood of 4200 lb. If the truck is to be lifted as well as its load, the elevator should have a capacity of at least 7500 lb., and should be at least 8 ft. wide, or preferably 10 ft.

Where the tractor and trailer system is used, the ramp offers a convenient way of getting from one floor to another. However, it is quite important to see that these ramps are long enough so that the grade is not too steep. The limit of good practice is 15%, although some manufacturers make quite a point of the fact that their trucks can climb a grade of even 25%. This is all right as a stunt for advertising purposes, but for actual operation it is better to make the ramp twice as long and cut down the per cent of grade by half. It is a fact that a truck going from one floor to another on a 25% ramp will use 40% more current than if the ramp were twice as long and only 12½% grade. The reason for this is that all trucks are equipped with the series motor which gives a large starting torque. It is a characteristic of this motor that the number of amperes drawn from the battery is proportional to the load put upon the motor, while the speed decreases with the load. For this reason a truck operating on a 25% grade uses twice as much current as a truck operating on a 12½% grade. The reduced speed on the steeper grade is such that very nearly the same time is consumed in climbing the steeper grade, although it is only half as long.

The small diagram on this page shows how the current consumption increases as compared to increase in grade. Up to 15% grade the proportion between the current consumed and the height climbed is within the limits of good practice, but grades above this figure are not recommended.

Editorial Comment

Promote the Idea of Service

SERVICE as the fundamental aim of public utility organizations has made much headway in recent years. Progressive utility managers recognize that service is the primary object of their business and constantly keep this idea before their employes. The result has been most beneficial in those communities where this policy has been consistently followed out. Not only is the service given to the public of high standard and therefore the appreciation of the public shown by its good will to the utility, but the entire attitude of the utility employes is raised to a higher plane. Instead of looking upon their employment merely as a ready means of gaining a livelihood, they find in it also opportunity to serve the community.

The success of the service idea among utility organizations prompts us to suggest cultivation of the same spirit among the employes of municipalities and other public bodies. Within the present year there has been shown contemptuous disregard for the interests of the public by policemen, firemen and other employes of several of our American cities as well as of cities in Canada, Great Britain, France and other countries. Strikes of municipal employes are becoming almost as common as among industrial employes. Let these employes be taught that it is an honor to serve their communities and with fair remuneration the quality and continuity of their service will be raised to the standard on which it should rest.

French Water-Power Development

HYDROELECTRIC power is one of the important agencies that is going to put France back on her feet after the gruelling devastation of over four years of frightful war. The taking over of certain German coal-mining districts for a period of years will barely compensate for the deliberate destruction of French coal mines, so that France will remain short of fuel as before the war. This shortage and high cost of fuel combined with similar shortage and high cost of labor will call for more power developed from what the French so appropriately call their "white coal"—glaciers, mountain snows and water falls.

These facts are very clearly set forth in an article on this subject by Dr. C. W. A. Veditz that appears in this issue. He shows that French hydroelectric development has not yet been carried out very extensively and that there is room for an abundance of it, in which American engineers and other interests should co-operate. The French authorities clearly recognize the potential value of hydroelectric power development especially at this time when every energy and resource must be bent to hasten that nation's reconstruction. Although financial and other difficulties may seem formidable just now, it is to be hoped that these may be cleared away so that that courageous country may have every facility to return to a normal industrial and commercial basis as soon as possible.

A Brief for the Static Condenser

POWER-FACTOR, what it is, what it costs, the manner in which it affects capacity of machines and conductors and voltage regulation are subjects that have been discussed so long, so often and from so many angles that it would seem that everyone connected in any way with alternating-current workings, whether in the small or the vast system, should be conversant with the extravagances and drawbacks of low power-factor.

The fact is we all realize what low power-factor means. But it is only when we are brought face to face with some difficult situation, or the colossal waste the low power-factor entails is brought home to us, that we come to the full appreciation of the true significance of low power-factor. It is then that we seek palliative measures, whereas we might have, not always but quite often, prevented the cause. And prevention is almost always preferable to cure.

However, taking it for granted that the power-factor could be raised to advantage—which is the condition that obtains in practically every instance, whether it be the small alternating-current generating installation of the industrial plant, or the vast network of transmission lines with its interconnected generating stations and ramifications of distributing circuits—the question to be settled is to what extent it will be financially worth while to raise the power-factor, what will it cost to do it, and what is the gain in investment, in improved operation, and so forth. The condition that exists is the condition that decides what alleviative measure should be adopted. If it be over-motorization or too many lightly-loaded transformers, the remedy may be to change matters by adopting apparatus better suited to the need. On the other hand, it might be more practical to cure the situation rather than prevent it.

Elsewhere in this issue appears an article on the application of the static condenser to power-factor improvement. This is the second article in the ELECTRICAL REVIEW within recent months on this phase of power-factor correction; although editorial comment has repeatedly bespoken the cause of the static condenser. In this article Mr. O. C. Roff reviews the cost and the objections of low power-factor in a man-

ner that makes one appreciate once more what a waste of material and fuel accompanies decreasing power-factors. He explains what the static condenser does and the conditions under which it may be successfully employed. The very limited application of the synchronous converter for power-factor correction, so limited and accompanied by so many objections that this piece of apparatus is rarely considered for corrective purposes, *per se;* and the much more flexible synchronous converter with its wide latitude in use, are both well understood. But the application of the static condenser, and the conditions under which it is an almost ideal piece of equipment are not so well understood. Mr. Roff's article should make the matter clear; and, incidentally, should serve to emphasize the many instances in which the static condenser should be used where at present low power-factor is tolerated where little excuse exists for such tolerance.

Electrical Engineering and Electrochemistry

IT IS the province of the engineer to utilize the forces and materials of nature. Chemistry is the science which deals with materials; and it is the chemist who studies the fundamental construction of materials, separating the common substances into their constituent elements, devising new combinations and producing new properties. Electricity, being a force, comes within the province of the engineer.

A combination of the two fundamental, forceful sciences—electricity and chemistry—the combination of the science of materials and the science of forces—has given the investigator, the inventor, the investor and the manufacturer a new vast field for action. And it is the combination of these sciences and these human associations that has, and will still more in the future, attain results otherwise unattainable.

The chemist, the electrochemist, utilizes electricity in two ways, according to what he aims to produce or attain: by high temperatures, as for the production of nitrogeneous compounds from the air and for the production of carborundum and steel; and secondly, by electrolytic action, as in the refining of copper, the electrolyzation of water for the production of hydrogen and oxygen. In these two ways, electricity has made vast and rapid progress in coming to the aid of the chemist, hence to the betterment of mankind. The full story is not yet told of what electrochemistry and the electrochemist accomplished in the waging of the World War.

Toward the close of this month the American Electrochemical Society convenes in Chicago. This is a comparatively young society, has a vigorous and active organization that has done much to co-ordinate effort and further matters pertaining to electrochemistry. The membership in the organization has increased very rapidly, almost phenomenally during the last few years, because of the vital importance that electrochemistry has played in the waging of war, and the vast field that remains to be explored and developed in the callings of peace. Many of the members are power engineers of the large central-station companies, for these men must be in touch with manufacturing methods "in readiness to serve" their clients; and continuity of supply of power is often of paramount importance.

Chemistry is a science unto itself; as is also electricity. But electricity facilitates chemical action and is sometimes indispensable. The electrical engineer does not need to be a chemist. But the electrical engineer well versed in chemical engineering is a better electrical engineer and is of greater value to himself and to his profession. And this, after all, is the criterion as we pass judgment upon ourselves.

Science and Marine Problems

ELSEWHERE in this issue we give particulars of some of the scientific achievements secured during the war in connection with the anti-submarine campaign. It is not too much to say that only the utter abandonment of the pre-war governmental attitude toward science in England cleared the way for investigation and practical application which were essential in dealing with what in the late months of 1917 was realized to be one of the most difficult problems ever presented to science for solution. It became necessary to introduce practically a new system of physical science and engineering and the British Admiralty agreed to broaden the field from which scientific and engineering talent could be drawn. Professor J. C. McLennan, fellow of the Royal Society, and scientific adviser of the British Admiralty at a Victory meeting of engineers held at Newcastle-on-Tyne has revealed particulars of some of the means and measures devised by scientific experts.

He confessed his inability to reveal everything of the kind, but vouchsafed such information as it was in the national interest to give in order to foster and stimulate co-operation in the development of science and of its application to naval and other marine problems.

It is interesting to learn that with a view to developing and extending the scientific results which were obtained under the stress of war, the British Admiralty has recently put forward proposals for a permanent establishment of a Department of Research and Experiment within the Navy.

Plans have been formulated for the erection of a central research institution for the investigation of first principles and for carrying on researches of a fundamental and pioneer character. Steps have been taken to organize a sea experimental station and to provide buildings and equipment for an engineering laboratory, a wireless and signal school, and a torpedo and mining school in place of "Vernon," and it is believed that these institutions will prove of great value in developing not only means of increasing the efficiency of the British Navy, but in providing aids to navigation for the mercantile marine.

Current Events

Pennsylvania Electric Association Meets—Electric Transportation—New N. E. L. A. Committee—Other Happenings

PENNSYLVANIA ELECTRIC ASSOCIATION HOLDS INTERESTING CONVENTION.

Quality of Papers and Exhibits Notable Features of Successful Meeting.

The twelfth annual convention of the Pennsylvania Electric Association, held September 3-6 at Bedford Springs, Pa., was opened by President Thomas Sproule, Philadelphia, who comprehensively reviewed the work of the past year, summing up what had been accomplished during after-the-war conditions.

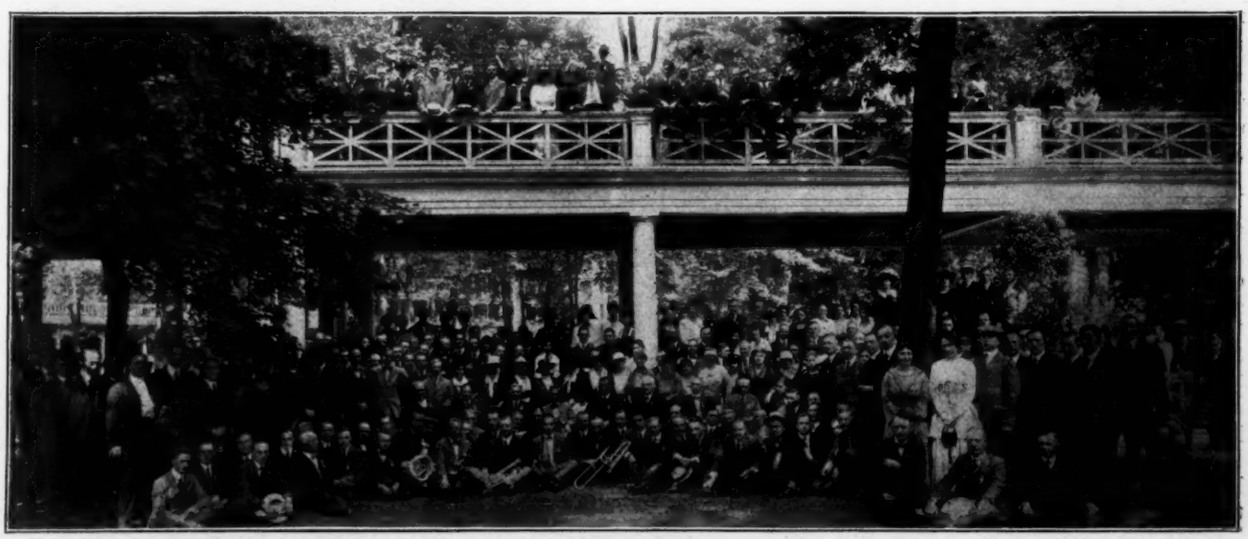
In reports of committees, that of the engineering committee was concerned with the joint use of poles and the elimination of the 5000-volt maximum clause, agreement on which will be reached later. Joseph B. Seaman, of Philadelphia, chairman of the geographic section's committee, reported on the feeling of goodwill and mutual helpfulness derived from the meetings of the different geographic sections.

The first paper to be presented was on "Increasing Capacities of Existing Lines and Cables" by E. C. Stone, Duquesne Light Co., Pittsburgh, in which was given the relations between line capacity, costs and voltage regulation when increased capacity is obtained by increasing the copper and by increasing the insulation. In a general way, voltage regulation is not only a criterion of service but also of line cost, and when it becomes excessive, usually money can be saved in investment and operating cost by increasing line voltage. Line capacity can also be increased by improving the power-factor and is warranted if the total saving in line, transforming and generating equipment is greater than the cost of making the improvements. By means of charts and tables, Mr. Stone showed a comparison of methods of increasing line capacity under different conditions. In the discussion, the question of using regulators on 2300-volt power circuits was raised. In regard to furnace operations, it was suggested that the effect of a furnace on the line is solely a question of variation between the furnace load and load that the line can carry.

John A. Barnard's paper on "Effect of War on Boiler-Room Practice" showed savings made during the past year at the Schuylkill and Chester stations of the Philadelphia Electric Co., these being accomplished by training an economical coal-burning crew and checking its work by use of instruments. The discussion dealt fully with the use of pulverized coal, culm and fuel oil in place of coal. The statement was made that if the price of fuel oil could be guaranteed as anywhere near permanent it would pay to make the necessary changes in equipment to install fuel oil apparatus.

E. H. Tyson, Lehigh Valley Light & Power Co., Allentown, read a paper on "Method of Operating a Meter Department in Scattered Territory," in which was outlined methods for the organization and operation of a meter department for such conditions. The discussion enumerated the difficulties in securing efficient men, and the thought was expressed it was a good plan to draw from high school graduates, who usually remain for an average of one or two years and require but a short period of training.

A paper on "Economical Boiler Room Practice for Medium Sized Plants" was presented by H. B. Bryans, Counties Gas & Electric Co., Norristown. Methods employed to obtain more efficient operation of the Norristown plant in the face of high labor and fuel costs were given in detail. The discussion brought out the suggestion that gas house tar is valuable as a coating for boiler settings because it does not dry out.



Assembled Delegates at the Twelfth Annual Convention of the Pennsylvania Electric Association at Bedford Springs, Sept. 3-6.

The Manufacturers' Exhibit of Electrical Appliances in the "Big Top" at the Convention of the Pennsylvania Electric Association Helped in Large Measure to Make Its Convention Very Successful.

The use of an agitator in hoppers was advised. The evaporation of oil in gauges was mentioned, with the suggestion that they be kept as far as possible from heat. Tissue paper scale on tubes and savings in replacement resulting from regular cleaning out of scale were also included in the discussion on Mr. Bryans' paper.

H. P. Weaver discussed his subject of "Management and Men" extemporaneously, dividing his talk under five heads: Sincerity, honesty, willingness to lay aside prejudice, practicalness, and conservatism. In speaking of sincerity, he said the mere desire to do the right thing is not enough; the management must understand human nature sufficiently to know what is a fair deal. Under "honesty," he suggested that we must be honest with ourselves and then it would follow that we would be honest with others. Mr. Weaver cautioned against nostrums in dealing with the management and men question. He said there was no one remedy or system to fit the problem, but that it must be handled intelligently. He urged the necessity of drawing out the latent abilities in men and creating a mutual understanding between the management and the men so that both may understand that neither has "hoof and horn." He expressed the thought that the doing away of the limitation of production would be one way and perhaps the very best way of meeting present conditions. Mr. Weaver's paper provoked a great deal of earnest discussion, and the thoughts he presented were commented upon at length, several instances being given of the application of his suggestions and of the satisfactory results achieved.

In his paper on "The Story of the Insulations," C. E. Skinner, Westinghouse Electric & Manufacturing Co., gave the history of the development of sheet insulations, insulating varnishes and oils, mica, molded insulation, and glass and porcelain insulators, and indicated the trend of insulations of the future. In the discussion upon this paper, Mr. Skinner's ideas were very heartily concurred in. It was suggested that the permanent confinement of the equalizing potential to the selected path constitutes reliability; therefore the reliability of electric light and power apparatus is absolutely staked on insulation. Insulation's hope of climbing from the weak link to the strong link position that it deserves lies in the increasing requirement of reliability. Insulating varnishes were spoken of as being still worthy of serious consideration. Attention was called to the changes that have come about in the uses of mica and to the fact that the use of mica in large pieces cut to size has been abandoned in this country.

G. E. Wendle, Lycoming Edison Co., Williamsport, presented a paper on "Selecting a Switchboard for a Plant of Moderate Size," in which was given a resumé of changes in switchboard installation necessary to care for increases in power load and a comparison of the advantages of truck and cell-type panels.

At the Friday evening session W. H. Johnson, vice-president of the National Electric Light Association, enlarged upon the work of the association and the good to be accomplished through its various geographical sections.

The Hon. William D. B. Ainey, chairman of the Public Service Commission of Pennsylvania, in his address referred to the subject of capital and labor, and to the necessity for them both to become better acquainted to the end that each could better understand the other. He said that there must be loyalty in service and loyalty in employment in order to insure harmonious relations and the accomplishment of the best good for both.

John W. Meyers, Philadelphia Electric Co., presented a paper on "Isolated Plant Costs as Influenced by the War," giving comparative figures on the cost of power plant materials and labor between 1916 and the present time, as well as reviewing economic features of the production and sale of electrical energy. Discussion on the paper was limited owing to the nature of the subject matter.

"Power-Factor Correction by Means of the Static Condenser" is the title of a paper presented by O. C. Roff, which is published in full in this issue. In the discussion it was stated that the static condenser will take a current which is proportional to the voltage and the kv-a. will be proportional to the square of the voltage. Accordingly, if the voltage decreases 10% the current will fall 10% and the reactive kv-a. by 19%. On the contrary, the synchronous condenser will take a considerably increased current and a somewhat larger reactive kv-a. This is due to the relative change of line voltage and excitation voltage, the decrease of line voltage corresponding to an increase in over-excitation since the excitation voltage does not change. The increase in current is approximately 20%, and the increase in kv-a. about 8% for a 10% drop in voltage.

It is evident then that the synchronous condenser will exert an increased correcting effect at the very time when the correction is most needed in order to maintain proper voltage while the static condenser will exert a decreased effect. This should not be interpreted to mean that the static condenser should not be used in any case, for it certainly is very much better than none at all, but is simply one of the points which should be considered in deciding upon the type of correction apparatus to be used.

It is interesting to note also the behavior of an induction motor under these conditions. If an average induction motor operating near full load and driving a load of constant torque, such as machine tools or hoists, experiences a 10% decrease in line voltage, the power component of the current will increase about 10% and the reactive component will be practically constant; that is, the necessity for correction is practically unchanged for moderate changes of voltage.

The officers elected for the succeeding year are: W. R. Kenney, Connellsville, president; Henry Harris, Pittsburgh, first vice-president; E. H. Davis, Williamsport, second vice-president; H. S. Cantlin, Allentown, treasurer. Members of executive committee (two year term), W. E. Long, Philadelphia; J. H. Shearer, Altoona, and G. M. Gadsby, Pittsburgh. Henry N. Muller was elected to fill out the unexpired term of Henry Harris.

ECONOMIC FUTURE OF ELECTRIC TRANSPORTATION UTILITIES.

Western Society of Engineers Conducts Symposium on Condition of Electric Railways.

An interesting symposium on electric railway problems of the times formed the topic of discussion at the opening meeting of the season held by the Western Society of Engineers in Chicago on the evening of Sept. 8. Four experts on electric railways presented different phases of the complicated economic problem.

The subject was opened by James R. Bibbins, of the Arnold Co., Chicago, in a paper introducing the problem as a whole and giving a historical review thereof. He showed the importance of the electric railway utilities to the communities they serve. Their capitalization of $4,800,000,000 has been subjected to heavy shrinkage. Not only have material costs risen, but wages also, while labor apparently has the whip-hand. The public has been educated to the 5-cent fare and demands that consideration be given only to the depreciated value of the properties. Some nine different remedies have been proposed, of which many are quite radical. Mr. Bibbins reviewed the history of a railway system in a large city with 5-cent fare dating to 1860. Fairly stable conditions existed up to 1890 when the line were electrified; the heavy capital costs thereof practically wiped out earnings for nearly 10 years. As they picked up again, optimism was felt and franchise renewals were accepted without proper allowance for depreciation. The 5-cent fare does not now yield sufficient income.

A paper by P. J. Keeley, president of the Kansas City Railways Co., on "Valuation and Accruing Depreciation" was read by Secretary Nethercut in Mr. Keeley's absence. At first the problems seemed local and greatly diversified, but more recently they have become national and crystallized into realization that the companies cannot render service on their present incomes. The Federal Electric Railway Commission may produce some valuable findings from its investigation. One feature coming to be recognized is that it is impossible to keep a street-railway property in better than 80 to 90% perfect condition, yet it can give 100% service. The practice set by the Wisconsin Railroad Commission of fixing rates on the depreciated value of the property is being abandoned by this and other commissions because it is essentially unfair to the investor. Valuation based on reproduction new is now the accepted practice because equitable. Solution lies in acceptance of the cost-of-service principle as basis for rates.

"The Actuarial Problem" was the title of a paper by W. J. Hagenah, consulting engineer, Chicago, read by Mr. Jirgal in the author's absence. Depreciation funds are seldom set aside specifically as such. The practice of accountants is usually to draw on the general surplus or reserve for renewals instead of on special depreciation funds. Each generation should bear its share of development expense and depreciation. Patrons must provide sufficient income to meet costs and investors must make proper allowance for current and accrued depreciation in order to permit continuous service and keep the property intact. Depreciation must be provided for in advance and the income must be sufficient to permit this. There is an undoubted tendency toward using the reproduction cost new as basis for rate making.

George Weston, consulting engineer, Philadelphia, presented a paper on "Electric Railway Policy." One of the most important problems is to secure harmony between labor and capital, then to promote economy and give the best possible service. Public authorities must be fair; in the past they have taken the "pound-of-flesh" attitude too often and denied a fair deal to the companies. Labor must be assigned a participating partnership in the business and compelled to assume its obligations. Assuring it full opportunity to have redress for wrongs, it must be deprived of the right to strike. Mr. Weston referred to the success of the Philadelphia Rapid Transit co-operative plan, which has been developed during 9 years. A feature of it is to promote thrift and stimulate service. Most companies cannot resort to such slow development of co-operative service in the present emergency and must have more revenue.

The subject was discussed by Colonel Junkersfeld and Messrs. Lewis, Bibbins, Mabbs, Jirgal and Stephenson.

TWO NEW COMMITTEES ARE ESTABLISHED BY N. E. L. A.

Committee on Service and Committee on Co-operation in Industry Are Formed.

President R. H. Ballard of the National Electric Light Association has received the acceptance from S. M. Kennedy, general agent of the Southern California Edison Co. of Los Angeles to act as Chairman of the Committee on Service, and from Lee H. Newbert of the Pacific Gas & Electric Corporation of San Francisco to be chairman of the Committee on Co-operation in the Industry. Both of these important committees will pursue lines of original investigation and will make reports along constructive lines to the national convention of 1920, which will be held in Southern California.

Mr. Kennedy's committee will work on the condi-

tions of service from this viewpoint: With the regulation of rates and finances by state utility commissions, to provide only safe returns on capital invested, and with a courageous attitude toward these regulating commissions to see that such return is allowed; electric utility companies are entirely out of politics and should devote their energies to the service of the public, without any encumbrance to the achievement of its highest development.

Mr. Kennedy is well known in the national forum of the industry both as a progressive official and an author.

Mr. Newbert's committee will endeavor to formulate and submit to the next convention a plan by which all of the branches of the electrical business may co-operate and to show specifically how this can be practically worked out in the geographic sections.

Mr. Newbert has been very active in the California Electrical Co-operative Campaign, of which he has for several years been chairman. This movement had its origin in the Pacific Coast Section, has met with remarkable success in the centralization of central stations, manufacturers, jobbers and contractor-dealers, and has demonstrated that they can work together for the general good of the industry. Chairman Newbert, in appointing the members of his committee, will make selections from all branches of the industry.

CENTRAL STATIONS CONFRONT PROBLEMS DURING READJUSTMENT.

Chairman Britton of Public Policy Committee, N. E. L. A., Outlines Policies to Be Adopted.

In anticipation of weighty problems that confront the central-station industry during the readjustment period, John A. Britton, chairman of the public policy committee, N. E. L. A., has written the following letter to members of that committee with a view to standardizing fundamental policies of public utilities, to place rate regulation on principles of equity, to promote water-power development in the West, and to correlate the work of the different committees so that the problems of the year may be handled consistently and well.

To the Members of the Public Policy Committee, National Electric Light Association:

As chairman of the Public Policy Committee of the National Electric Light Association, I wish to discuss with the members of that committee the policies deemed essential by me to be pursued during the coming year.

First and foremost, I am in sympathy with and ready to stand back of all the plans which have been suggested by President R. H. Ballard, and pledge myself to support him in his more than laudable effort to make his administration year a record one for the association. I hope that the members of our committee will assist Mr. Ballard in securing men of prominence in the industry for chairmen and members of several new general committees he is trying to organize to work out the big problems now confronting us. These will require the thought of some of the best minds and work of the best men.

We of the West want the East to know us better. We want to expand the usefulness of the association; we want it to be nation-wide in its influence. It can be of the greatest good.

The fundamental policies which must govern the attitude of public utilities should be alike. In my judgment this can best be accomplished through the suggestions made by our president, particularly with reference to the formation of Geographic Sections.

The methods of approach to the rate regulating bodies must be upon sound principles of equity. Individual opinions enforced through argument in special cases should not be permitted to raise questions inimical to the public utilities as a whole.

The East has never been appreciative of the necessities of water power development; it has been more or less inactive in support of Western needs and conditions. This condition must be remedied.

Standards should not be encouraged in one section of the country that might be detrimental to other sections. In this concert of action is necessary.

The Public Policy Committee should be a judicial body acting upon the general questions raised in the association and coming through the avenues of the different committees. For that reason it should be closely in touch with the action of all committees, but more especially the Executive Committee, and should have intimate knowledge of what is being discussed and of the problems that concern each of the subdivisions of the organization. I have arranged with the president that copies of the minutes of the Executive Committee meetings will be sent to each member of the Public Policy Committee.

If ever there was a time in the history of our association when to overcome the insidious working of antagonistic interests we should stand together, that time has now arrived.

National legislation and state legislation should be correlated with the needs of all states, so as not to form dangerous precedents. Matters of this kind can best be worked out through the agency of such a committee as the Public Policy Committee.

I want each and all of you to pledge yourselves to a shoulder-to-shoulder campaign with our president. Like the West from which he comes, he is progressive, ambitious and resourceful.

I am sending a copy of this letter to you, to each of the vice-presidents, and invite from you and them such suggestions of matters to be considered at the meeting of the Public Policy Committee to be held in September as may occur to you as things that should receive consideration at the hands of that committee in line with the policies which I have outlined in the preceding paragraphs.

Yours very truly,
JOHN A. BRITTON,
Chairman, Public Policy Committee, N. E. L. A.

MANY FEATURE EXHIBITS PLANNED FOR NEW YORK SHOW.

Model Electrical Home and Complete Vehicle Display to Be Shown at Exposition Sept. 24 to Oct. 4.

A model of a modern home, in the form of a small apartment equipped with electrical machinery and devices which either supplant entirely or greatly lighten the manual labor associated with the operation of a household will be a feature exhibit of both interest and value at the New York Electrical Exposition which opens Sept. 24 in Grand Central Palace, New York City. These machines and devices are literally as well as figuratively electrical servants.

The idea of the model home originated with Arthur Williams, Federal Food Administrator, and also head of the exposition. He called together a staff of experts and told them to lay out an average small home, and then to apply electrical devices and machines to every manual labor task necessary for its operation. They have succeeded beyond expectations and found many new inventions applicable to the work. Altogether a remarkable demonstration of the emancipation of household drudgery through the modern application of electricity is provided.

In addition practically every make of electric passengar car and electric motor truck, including the small industrial trucks, will be exhibited. There will also be numerous displays of the various accessories applicable to the electrical vehicle, ranging from batteries to decorative lighting. Those engaged in the automobile business will have a further interest in the electrical show, because of the many exhibits of electrical devices for the garage and repair shop and the wonderful displays of electric lighting and decoration for large showrooms.

Commercial Practice

Successful Merchandising Methods—Refixturing Campaign of Commonwealth Edison—Advantage of Irons as Specialty

ELECTRICAL MERCHANDISING METHODS OF DETROIT EDISON CO.

Abstract of Interesting Paper Read at Michigan Section Meeting by A. H. Touscany.

The methods employed by the Detroit Edison Co., Detroit, in conducting and promoting the sale of electrical merchandise in its territories were fully described in a paper, "Electrical Merchandising," presented at the recent convention of the Michigan Section of the National Electric Light Association by A. H. Touscany.

In Detroit, this company sells only lamp socket heating devices such as irons, toasters, etc., leaving the marketing of the larger devices to the electrical contractor-dealers, department stores and hardware merchants. There are about 250 such stores in the city at present. A number of these, having important agencies, support excellent selling organizations. During 1918, approximately the following number of major devices were sold: 16,979 cleaners, 8153 washing machines, 1335 ironing machines and 1536 sewing machines.

Most of the business is obtained by soliciting and it can safely be said that no housewife in Detroit need go shopping for such devices. Because of the existing competition every reasonable courtesy is extended to the customer.

The one device that the Edison company will perhaps always handle is the flat iron. This is because many of the other merchants have a tendency to handle the cheaper lines of this appliance and if the business were left entirely to them the company's lines would be flooded with low priced goods of inferior makes that would cause considerable trouble.

In the small towns outside Detroit, known as the Eastern Michigan Division, little or no attention is paid to the development of the electrical appliance business by the local dealers. In order to develop these territories the company carries an adequate stock of devices in all its local offices.

By establishing such stores it is also hoped to bring the small town dealer to a better realization of the opportunities offered in the sale of electrical appliances for in the future a large portion of his business will come from this source.

In this connection the possibilities of the electric appliance business were brought out. The range, washer, cleaner, sewing machine and ironing machine were described as the popular major electrical devices of today and will undoubtedly be sold in ever increasing quantities in the future. The dishwasher and clothes drying machine are devices expected to be brought forth in the near future and the electric refrigerator has already been developed but not exploited as yet to any extent. In addition, electrical merchandise is the cleanest line of merchandise there is today, and every time a labor-saving device is sold the customer is rendered a valuable service which gains his confidence and good will—a wonderful asset to any business.

In regards to the methods used to stimulate appliance sales, Mr. Touscany is of the opinion that the house-to-house hawker method of selling is undesirable for a central station to employ. It is true a certain amount of educational work must be done but it seems to him that a certain portion of the line is sufficiently introduced to make it unnecessary to continue what is considered by the largest and most succussful merchants to be a most undesirable method of getting business.

In its Eastern Michigan Division in which there are 30 display rooms the Detroit Edison Co. is endeavoring to market electrical appliances in much the same way as a hardware dealer sells his goods. It is trying to teach its customers through window display, newspaper advertising and store demonstrations the uses and advantages of electric appliances. By pursuing this policy the merchandising business in this division is growing steadily,—the 1917 sales being 50% greater than in 1916, in 1918 they were 85% greater than in 1917 and during the first six months of this year it has had a 148% increase over the same period last year.

Everything is sold at manufacturers' list price, no commission or bonuses are paid and no free wiring is done. The company believes in local newspaper advertising but does not advertise any particular make of appliance, and although nationally advertised products are preferred it does not disfavor new lines being put on the market. Advertising matter is sent out in the monthly bills but the company's name does not appear on the advertisements. The show windows are also used as advantageously as possible and the returns justify all the time, money, care and thought that is put into them. It has been found that the simple window exhibiting a single thought is the most successful. Such windows can be trimmed more easily and the displays are changed as often as three times a month.

Special attention is paid to store arrangements and the stores are so arranged that a customer in paying a monthly bill walks through the entire display. All of the small heating devices are kept in glass show cases which not only adds materially to the appearance of the store but allows a sample of each device to be kept on display constantly without depreciating their value. Washing machines and ranges are connected so that customers can see the devices in action.

All our appliances are sold on a deferred payment basis, and although there is no set rule governing time and payments, terms are usually arranged to suit the customer's convenience. Every opportunity to demonstrate to customers is taken advantage of and it is found that the stores doing the must demonstrating make the greatest number of sales. The value of

dignified store solicitation cannot be over-estimated and the increase in business is largely due to the fact that the merits of electrical devices are being continually demonstrated in all display rooms. Service, of course, is the most essential requirement. One of the main reasons for a central station being in the appliance business is because it furnishes a greater chance to serve the customer.

As mentioned before, the Detroit Edison Co. offers no bonuses or commissions to its sales people in the sale of appliances. Recognizing that there should be some incentive offered, a comparative appliance sales report is issued each month. These reports are not only sent to each local office, but to all officers of the company interested in the development of appliance sales. This report not only indicates the amount of appliance sales for each town and district, but it shows the amount of appliance sales in cents per meter. Because of the close attention that is paid to this report by various officers of the company and because the district agents are vitally interested, each local agent is very anxious to make a good showing for his community.

In conclusion, the paper called attention to the necessity for enthusiasm in selling electrical appliances. Enthusiasm is the biggest word in business today. Cash can buy, but it takes enthusiasm to sell. The slogan of the best salesman is "Enthusiasm," because it is the zeal that puts zero in competition. Enthusiasm is what gets you home from third. It is that power that compels you to stick in the home stretch. Without it, the fullest measure of success cannot be achieved as it is the contributing factor of any finished product. The best clerks, the most resourceful salesmen, are those filled with enthusiasm. Each and every one of us dealing in electrical appliances should be filled with a sincere enthusiasm for the wonderful line of merchandise which we sell.

TENANTS URGED TO BUY THEIR OWN LIGHTING FIXTURES.

Commonwealth Edison Co. Plan Enables Apartment Building Tenants to Improve Lighting Conditions.

For many years central stations, contractors and the rest of the electrical industry, as well as the public, have realized that the lighting fixtures installed in the average apartment building left much to be desired both from the artistic and practical viewpoints. This is due to the fact that the lighting fixtures are usually the final purchase in constructing a building and must be paid for out of the money left over after all other expenses are paid. On account of the large number of extras encountered in the construction, this amount is seldom as large as originally intended and the cheapest possible fixtures are usually installed.

In addition practically every occupant of such a building possesses a different style of furniture and for each of these styles there should be installed a corresponding electric fixture if the best results are to be obtained. People will go to a great deal of expense to purchase furniture of a certain period or style and arrange it tastily only to have the whole effect spoiled by a lighting fixture that is not in harmony with the rest of the room, for the lighting fixture dominates everything else in the room. Furthermore, existing lighting fixtures are seldom used properly. They are either equipped with lamps of a size too large or too small or every socket is not filled with a lamp.

To overcome this condition a fixture department has been added to the Electric Shops of the Commonwealth Edison Co., Chicago, where tenants may purchase their own fixtures to harmonize with their furniture and individual tastes. The fixtures are sold on the time-payment plan which makes their purchase much easier. Although the plan is a comparatively new one and has not been widely advertised as yet—the advertisement reproduced herewith being the only one to date—the demand for fixtures is already exceeding all expectations and promises to become an important factor in its business.

NOTICE
to
TENANTS
Own Your Fixtures as You Do Your Furniture
Many a tenant, moving into an apartment, finds fixtures that, even if modern, are discordant with the period furniture. The problem is solved by selecting and owning fixtures in keeping with such furniture—replacing the landlord's fixtures during tenancy.
The Fixture Room at Our Electric Shop
We make this easily possible. The Fixture Room at Electric Shop displays a most comprehensive variety of period as well as modern designs in artistic effects, in keeping with every possible need. Select the fixtures you wish—we will arrange for their installation in your apartment.
Small Monthly Payments
Make a small payment, and you may pay the balance—added on your lighting bills—spread over eleven months.
Tenants and Landlords
Whether you are a tenant, or a landlord, you are urged to avail yourself of the convenience afforded by this plan.
COMMONWEALTH EDISON
ELECTRIC SHOPS
72 West Adams Street
ELECTRIC SHOW COMING OCTOBER 11-25—COLISEUM

Recent Advertisement of Commonwealth Edison Co. Electric Shops Urging Tenants to Buy Their Own Fixtures.

SEWING MACHINE DEALERS URGED TO HANDLE ELECTRIC IRONS.

A recent issue of *Sewing Machine Times*, a publication devoted to the interests of the sewing machine trade, contained an interesting article explaining the advantages of carrying a line of electric irons as a specialty for dealers in that line. It was pointed out that by handling such devices as a side line the sales of sewing machines and other appliances could be materially increased. The sewing machine dealers were urged to take advantage of the advertising and sales campaigns conducted from time to time by electrical manufacturers and central stations by tying in their own advertising and concentrating their sales efforts on these articles during such periods. The article then described the methods that have been used with success in the past by different electrical interests in the conduct of such campaigns.

Without attempting to discuss the desirability of such a procedure from a practical point of view it surely indicates the attractive selling qualities of such appliances and it is interesting to note that another industry recognizes the great demand that has been created for electrically operated appliances and the advisability of handling them.

Operating Practice

Intermittent Ground in Turbogenerator Field—Heating of Underground Conductors—Synchronous Motor Ammeters

OBSTRUCTION IN VENTILATING DUCT CAUSES INTERMITTENT GROUND.

Peculiar Ground Existed Only with Machine in Rotation. Location of Cause and Moral?

Many companies make it a practice to test periodically the fields of their machines for earths or grounds. In this way many occurrences can be brought to light and worse happenings prevented. In steam generating stations containing turbogenerators and extensive exciter systems it is particularly advisable to make frequent tests for grounds on the exciter system and the generator field circuits.

In one instance recently a rather peculiar form of ground occurred. When making the periodic tests for grounds it was discovered that one of the turbogenerators had a ground on its field. This unit was of 25,000 kw. and was in service at the time the ground was discovered. When the unit was shut down, repeated tests showed that the ground had disappeared. Starting the machine again showed that when up to speed or nearly so, the ground existed, but when the machine was at rest or turning over very slowly it had disappeared. Such grounds occur frequently, and are usually found in the flexible leads that pass from the actual field coils to the rings, and may be due to frayed insulation, the collection of greasy dirt containing conducting particles such as metal dust.

As it was found impossible to locate the ground by test or inspection it was necessary to take out the field and remove some of the field end plates. The fault was found to be half way down in one of the slots directly in line with the spot where the field leads come out of the field. End plates were removed from each end of the field and the insulation on the end turns of the field coils was then found to be damaged quite extensively. The reason for the damage was found to be due to the fact that the bolts holding the end plates in position had been pulled up so tightly that the insulation on the coils had been badly crushed. As bearing out this cause of damage to the insulation, was the further fact that the supporting studs against which the end plates are pulled up against were badly buckled and marred, the end plates themselves even being sprung where the bolts passed through.

On pulling out the defective coils, it was found that the ground had been occurring in the bottom of the slot directly on top of one of the ventilating ducts. At this point inspection of the core showed that a brass wedge, such as is employed for securing the pole laminations, was resting in that ventilating duct that terminated at the fault in the field conductor. This wedge was standing on edge and was free to move backward and forward along the ventilating duct, according to whether the field was turning over or at rest. When the field was rotating, this wedge was thrown out against the faulty conductor, striking the insulation at the point where it had been cut and causing a ground.

The cause of the ground on the field resulted from the wedge, the crushed insulation due to the end plates being pulled up too tightly, being only incidental and a fact that was brought to light only because the conductor in a certain slot was pulled out. While being a weakness, the crushed insulation had not caused trouble up to the time the field was overhauled. The moral from this incident seems to be that special precautions should be taken to prevent loose objects from being left in ventilating ducts and similar places, and that the force that it is possible to exert through the leverage of wrenches, etc., be not abused, as had obviously been the case in the present instance, since the end plates had even been sprung.

HEATING OF UNDERGROUND CONDUCTORS UNDER INTERMITTENT LOAD.

Abstract of Paper Describing Experiments Before A. I. & S. E. E. in Philadelphia.

By A. L. Freret,

Assistant Electrical Engineer, Tennessee Coal, Iron & Railroad Co.

When a conductor is carried in conduit buried in solid material, convection of heat is prohibited and the heat created by the current must be dissipated by conduction through the insulation and through the conduit into the surrounding substance. The amount of heat so dissipated through conduction is roughly proportional to the temperature difference between conductor and surrounding solid substance, and is also proportional to the area of radiating conductor.

The process of conduction of heat from the cable is so slow compared to the process of convection from a conductor suspended in air that the limiting carrying capacity of the underground cable is the temperature dangerous to the insulation. This temperature is reached long before the power losses represented by the heating reach values which need be seriously considered.

Obviously, heavier currents can be employed when they exist only intermittently than when existing continuously, and experiments were carried out to determine safe loading with intermittent loads. The experiments were carried out by constructing a pine box 10 ft. long, and 1 ft. wide and high, the pine boards being ⅞-in. in thickness. Several rubber-covered cables were laid at different times in the box and surrounded by ground firmly packed. Heat runs were made and the current and time required to attain 100° F. was noted.

Tests were then made to determine the effect of an intermittent current upon the temperature rise of the conductors. Current was applied for one minute, was shut off for two minutes, and then on again for

one minute, and so on for two hours. In the case of a 2/0 cable carrying 200 amperes with the intermittent current of 200 amperes on one minute and off two minutes, after two hours a temperature of 107° F. was attained compared with 180° F. for continuous load, a difference of 73° F. In the case of a 4/0 cable carrying 300 amperes, the temperature attained with intermittent load was 120° F. compared with 220° F. continuous load, a difference of 100°.

The conclusions reached are that with an intermittent load, one minute on and two minutes off, an underground cable need only have 56% area of the conductor for carrying the same load continuously.

The foregoing shows that the current being intermittent, the heating of the cable really depends upon the mean effective current, which is the square root of the mean squares of the current. In the case where the current is on and off the same length of time, that is, one minute, this would correspond to the $\sqrt{2}$ and for current alterations amounting to one minute on and two off, this same value is very nearly correct, so that the simplest way to arrive at the safe value of current for underground cables in intermittent service would be to use the manufacturer's rating multipled by the $\sqrt{2}$.

EXPERIENCE OF THE HAZARDS OF SYNCHRONOUS MOTOR FIELD AMMETERS.

Relative Methods of Starting Motor—Location of Field Ammeter.

By B. H. Smith.

The synchronous motor has passed through a stage of development during the last five years by which its operating characteristics, pull-in torque, starting torque and stability in running have been greatly improved. Today, the synchronous motor can replace the induction type of motor for many applications, whereas its use would not have been even considered a few years ago. However, while there are many modern synchronous motors in service, with the latest improvements, there are also many of the older types still in service, with their shortcomings and their dangers. The following serves to emphasize one of the dangers of the old methods of starting synchronous motors and how it could be overcome under such circumstances, and how the danger has been eliminated by recent improvements in motor design.

Methods of Starting Synchronous Motors.

When starting a synchronous motor from rest, a partial voltage is applied to the armature or stator. The field winding or rotor acts as the secondary of a transformer, of which the primary or stator is the winding to which potential is applied. Under these circumstances, of course, a voltage is induced in the field winding of the synchronous motor, this voltage depending upon the ratio of turns in stator and rotor, the applied voltage, the frequency in the rotor circuit or flux density, according to the familiar transformer equation.

At the instant of starting from rest, the potential induced in the field winding is a maximum, because the frequency of the stator is the same as that of the rotor. As the rotor gains speed, the frequency of the rotor becomes lower until the motor "pulls in," when the frequency of the induced current in the rotor is zero, because no potential is induced since no flux is cut by the rotor.

The ratio of field turns to armature turns of the synchronous motor is such that at the time of starting a high voltage is induced in the field winding. To guard against breakdown of the field coils, it is the custom to break up the field winding into sections, thereby limiting the number of turns in series. In the latest types of synchronous motors it is the practice to start the motor with the field short-circuited upon itself through a resistance, thereby preventing the piling up of a potential dangerous to insulation or persons. Moreover, the low-resistance bars or winding in the pole pieces also serves to reduce the induced potential in the field while the motor is being started up. In other words, the synchronous motor of today presents little danger to insulation or to persons.

As many of the older types of synchronous motors are still operating, it may be instructive to describe a serious accident that occurred, explaining the manner in which it could have been and has since been avoided. The synchronous motor was employed for driving an alternating-current generator and thereby changing the frequency from 25 to 60 cycles. The motor was rated at 1000 kw. and operated at a line pressure of 9000 volts, 25 cycles. The motor was equipped with wattmeter, voltmeter and ammeters on the alternating-current side and with a voltmeter and an ammeter in the field windings.

Location of Field Ammeter.

The motor was started up from an autostarter or autotransformer, at about 50% line voltage, or 4500 volts. It so happened on the day under consideration that the chief operator was supervising the starting of the unit by an assistant operator. The former was standing at the switchboard, before the panel controlling the unit to be started, with one hand resting upon the case of the ammeter in the synchronous motor field circuit. When the assistant operator closed the motor to the autotransformer, the chief operator received a shock that caused him to be unconscious for several minutes and that resulted in burns that kept him in the hospital for several weeks.

A consideration of this case shows that (1) ammeters in the field circuit of synchronous motors should be treated with the respect due to apparatus subjected to high voltages, and should not be touched while the motor is being started; (2) that the ammeters of synchronous-motor fields should be located on the exciter bus side of the field circuit-breaker so that the ammeter and its shunt are isolated from the field coils until excitation is applied to the field winding.

In the present instance the synchronous motor received its excitation from two sources, an exciter at the end of the synchronous motor shaft and a separately driven exciter set. The ammeter was located close to the field winding of the motor, so as to shorten up the heavy leads from the direct-connected exciter. In other words, the circuit-breaker located at the rear of the switchboard only controlled the separately driven exciter set. The same result could have been obtained by installing the circuit-breaker on the panel carrying the knife switches for the direct-connected motor exciter.

With the present-day practice of short-circuiting the synchronous-motor field through a resistance, plus the grid resistance winding in the pole pieces, the danger mentioned above is very remote. However, as there are many of the older types of synchronous motors still in service, the precautions outlined above deserve consideration.

Contracting-Construction

Co-operative House-Wiring Campaign in Chicago—English House-Wiring Problem—Effort to Standardize Construction

HOUSE-WIRING CAMPAIGN TO BE CONDUCTED IN CHICAGO.

Union Officials Call Meeting to Arrange Plans for Campaign During Coming Winter.

About 110 Chicago members of the Illinois Electrical Contractors Association were present at a meeting held in Chicago on Sept. 5. This meeting was called by the officers of Local 134 of the International Brotherhood of Electrical Workers and in addition to these officers and the contractors there were present representatives of the Commonwealth Edison Co. and of the Electrical Inspection Department of the city. Charles Paulsen, president of the labor union, presided.

The purpose of the meeting was to arrange the plans for carrying on an intensive campaign to wire existing buildings during the coming winter and to work out a solution to some of the problems encountered in such work. Due to labor difficulties that have risen in Chicago and for which the electricians' union is by no means responsible, construction work in this city has been practically at a standstill and with the cold weather coming on it is not probable that it will be resumed to any extent until spring. In order to provide work for the electricians therefore, it was decided to urge the local electrical contractors to exert every effort they possibly can toward securing a large number of old house-wiring contracts during the winter period.

The principal speakers on this occasion were Victor H. Tousley, chief inspector of the city's inspection department; E. W. Lloyd, general contract agent of the Commonwealth Edison Co.; M. J. Boyle, business agent for the labor union, and J. W. Collins, secretary of the contractors' association. Mr. Tousley explained very clearly the requirements and provisions of the new Chicago license ordinance, which was described in our issue of Aug. 9. A lively discussion followed in which the advantages of the new ordinance and many of its important provisions were fully brought out.

Mr. Collins explained the arrangements which he has recently completed for bonding the members of the association. Under the new ordinance each contractor is required to provide a $5000 bond. Mr. Collins has arranged with a prominent company to bond all the members of the association collectively. This has reduced the amount of the individual bond fee to a large extent, more than enough to pay the association membership dues, and has resulted in a great increase in the membership. He has also arranged with a local banking company to finance a time-payment plan for old house wiring for the membership of the association, whereby the contractor can receive cash immediately for his contracts and the bank accepts the responsibility for making the collections.

Mr. Lloyd spoke of the Chicago Electrical Show to be held Oct. 11 to 25 at the Coliseum. The success of this show is already assured and the contractors were urged to co-operate and participate in it as far as possible. All of the electrical contractors' associations in Chicago have co-operated and made arrangements for a booth at the show and the state association will hold a meeting while the show is in progress.

The difficulties encountered in conducting the old house-wiring business in Chicago were then discussed. The principal difficulty seems to be in getting the buildings connected after the wiring is completed. In order to overcome this the electrician, contractor, central station and the inspector must co-operate very closely to avoid any unnecessary delay. Several plans have already been developed to accomplish this, but to date these have only been successful in a small degree. As a result of this meeting, however, steps are to be taken by the various factors in the industry which will undoubtedly result in the elimination of such delays.

INTERESTING FEATURES OF ENGLISH HOUSE-WIRING PROBLEM.

J. W. Beauchamp Advocates Use of More Completely Manufactured Fittings to Reduce Labor Costs.

Some interesting information regarding the wiring costs of small buildings in England was recently brought out in an address by J. W. Beauchamp, director of the Electrical Development Association, before a joint conference of electrical engineers, contractors and supervising electricians recently.

In this address Mr. Beauchamp stated that it was seldom that an opportunity occurred of wiring a large number of houses at the same time in quantity and in a businesslike manner, and at a time when the construction of the houses was not completed. Generally the houses are wired one at a time and are in quite a completed condition, which involved a lot of extra work.

Assuming the case of an average house situated about a mile from the shop of the wiring contractor, it would appear that at pre-war prices some 10 to 15% of the labor cost in wiring was spent for "walking time" and the transport of materials to the job, leaving only 85 to 90% of the labor cost for effective operation within the house. Today, the percentage lost in this way has increased to 15 to 20%, owing to the change in the working hours. It was obvious that everything possible must be done to reduce the number of days spent on any job of this kind and to expedite the transport of men and materials to the job; very strong arguments in favor of using some form of mechanical transport for conveying both men and materials. Where an estate or block of houses was being wired, a clerk and a hut could be set on the

job, stores accumulated, and a great deal of loss avoided.

Another point was that the underlying principle of improved wiring systems was to get a larger proportion of the money spent in a factory and a lesser proportion spent actually in the house being wired. For example, in a standard building wired in a simple way throughout with plain pendants, the usual class of material and conduit, and full-price trade union labor, it appears that the total cost (without overhead charges and profits) is divided as follows:

	Per cent of total cost. 1914.	1919.
All fittings and accessories	14	17
Cable	15	12
Conduit	13	17
Labor	40	41
Lamps	18	13
Total	100	100

Thus, although the total cost was almost exactly doubled, there had been no great change in the relative proportion of the cost of the several items. The manufactured fittings, conduit, and the labor were up a little; cable was relatively lower, and lamps are reduced by a substantial percentage. For these reasons there is no great prospect of reducing the labor cost, excepting where large blocks of houses were being wired at once and better organization and more division of labor could be brought together to effect economies.

However, Mr. Beauchamp believes that by giving the workmen more completely manufactured articles than coils of wire and lengths of tube and thus bringing more of the work within the four walls of a factory the labor cost could be materially reduced. After amending the present regulations if possible to permit the use of simpler and less elaborate wiring systems, the industry should then devise a system in which the wiring and fittings were produced in the most finished possible form in the factory, leaving the smallest call upon the skill of the workmen to fit them neatly to the installation.

Mr. Beauchamp also called attention to the fact that the percentage of the total cost of electrical work expended for labor was very high compared with other accessories of the house, for instance, the fixing of the fire grates, hot water systems and baths. In the case of these other articles the cost of the goods as purchased from the manufacturer was much higher in relation to the cost of installing them than was the case with electric wiring. This proves that such articles are much more completely finished in manufacture than electrical devices.

COMMITTEE FORMED TO STANDARDIZE CONSTRUCTION.

New Committee of National Federation of Construction Industries Expected to Solve Problem.

One of the greatest problems confronting the construction industry at present is the lack of standardization. This applies to building codes, to state legislation relative to licensing and inspection as it refers to construction and care of buildings, to building equipment of all kinds, to construction materials, to building specifications, to contractors' methods of bidding, etc., to financial operations in connection with construction, and to other considerations involved in the construction industry.

If it were possible for manufacturers of construction materials to standardize their product into a minimum number of varieties compatible with successful building operations, the manufacture of such material could be placed upon a bulk basis which in many cases is now impossible. Quantity manufacture has made the United States supreme as an industrial nation. The construction industry, however, is in many particulars so unstandardized that quality production is now impossible.

In order to overcome this difficulty the National Federation of Construction Industries has recently created a Committee on Standardization which will be formed as rapidly as possible. It is intended to organize this committee so as, if possible, to reach into all phases of construction interests, since it will be practically impossible to effect standardization without the co-operation and assistance of all of the interests concerned. The work of this committee will undoubtedly extend over a number of years, and the results which are possible of achievement are at the present time almost beyond estimate.

BOSTON DISTRICT CONTRACTORS TO HOLD IMPORTANT MEETING.

Report of Activities at National Convention of Contractors and Dealers to Be Read.

There will be a meeting of the Boston district of the Massachusetts State Association of Electrical Contractors and Dealers on Sept. 18 at the Boston City Club. On that occasion, Alfred J. Hixon, National Committeeman from Massachusetts, will make a report on the activities of the annual convention of the National Association of Electrical Contractors and Dealers in Milwaukee. Many matters of vital importance were considered at this convention and notwithstanding the fact that they have been published in the trade press, Mr. Hixon will give a more lucid explanation than it would be possible to obtain from reading matter. Also the members will have an opportunity of asking questions upon matters not fully understood from reports of the National Secretary.

It is particularly desirous that a large attendance be present at this meeting, as it is possible that later on the association may be called upon to express an opinion upon vital questions that possibly may affect the entire industry.

REQUIREMENTS FOR RUBBER-COVERED WIRE IN AUSTRALIA.

Commonwealth Imposes Rigid Specifications on Manufacture of Wire.

In order to insure the quality of the rubber-covered wire used in Australia and keep the possibilities of danger or fire arising through the failure of insulation at a minimum the Australian Commonwealth authorities impose the following regulations on rubber-covered wire: Each coil must bear (1) the maker's name and address; (2) the length of wire; (3) the date of manufacture; (4) the gauge of conductor; (5) the insulation resistance per statute mile after 24 hours' immersion in water at 60° F. and one minute's electrification at . . . volts—the voltage to be plainly marked on the label—or details of the test voltage applied, or other definite and comprehensive description of quality.

QUESTIONS AND ANSWERS

All readers are invited to submit questions and answers to this department. Anonymous communications will not be considered. Questions should relate to electrical matters of any kind. Answers contributed by readers should be submitted preferably within eight days of the date of publication of the question and should be limited, if possible, to 300 words. Payment will be made for all answers published.

Questions.

No. 464.—TRANSFORMER DESIGN.—I am trying to build a transformer with 110-volt primary and 14 steps on the secondary varying by 7½ volts up to 105 volts, thus, 7½, 15, 22½, 30, etc. Each step must be capable of carrying 10 amperes. What size and amount of wire is necessary on the primary and secondary windings?—W. A. S., Augusta, Kans.

No. 467.—OPERATING COST OF ELECTRIC HOUSEHOLD REFRIGERATORS.—I would like to know from some reliable source what is the operating cost of the electrically operated refrigerators that are being recommended for household use. What is the experience as to their dependability?—R. H. T., New York, N. Y.

No. 471.—RINGLEMAN CHARTS FOR DETERMINING SMOKE DENSITY.—The use of Ringleman charts is frequently mentioned in connection with the determination of the density of smoke emitted from smokestacks. I would much appreciate an explanation of what the Ringleman chart actually is and how the density of smoke may be determined from its use.—M. A. P., Spokane, Wash.

No. 472.—REWINDING A TRANSFORMER.—I have the complete core and case of a 2½-kw., type H, 60-cycle G. E. transformer which I would like to rewind for the ratio of 88-176-volt primary and 115-230-volt secondary of about 2 kw. capacity. The inner core is 3 by 3 ins., extending over the outside of the coil in four equal sections of 2½ by 1¼ ins. cross-section, leaving a winding space around the core of 2 by 5¾ ins. The original voltage ratio was 1200-2400 primary and 120-240 secondary. The use of this transformer is to be for intermittent service only of about 2 to 3 hours' duration for demonstration of fractional-horsepower alternating-current motors. Please advise what size of wire and number of turns to use on primary and secondary windings. Would it have to be oil-cooled like the original? Would a 2-hp. direct-current motor, old style G. E., wound with two No. 14 B. & S. wires in parallel, wave-connected, running as converter on 115-volt direct-current line, be sufficient for this purpose or would it be necessary to decrease the capacity of the transformer to suit the converter? The present alternating-current voltage obtainable at the converter averages 88 volts, 60 cycles, single phase.—V. S., Portland, Ore.

Answers.

No. 468.—WIRING LIGHTS FROM A BELL-RINGING TRANSFORMER.—Is there any provision in the National Electrical Code against reducing 110 volts to a lower voltage by means of a bell-ringing or toy transformer and then wiring some small lights from this? Is it all right to run this wiring in the same way as ordinary bell wiring? If this is permitted, what is the highest voltage and wattage permissible on such bell wiring?—S. T. E., Bridgeport, Conn.

I find no provision in the Code covering this class of wiring and would conclude that it is not prohibited. The local inspector would have to be the judge as to the voltage and wattage permitted on bell wiring; my own opinion would be not over 12 volts and 10 watts. I should advise using No. 18 or 16 wire if the lamps are located at a distance over 50 ft. (one way) from the transformer or if the load is as much as 25 watts on 24 volts; this is to prevent excessive voltage drop and therefore poor light from the lamps and also to make a more substantial installation. There is not much to be gained from such wiring unless the lamps are very small and used for signals or decoration instead of real illumination. Christmas-tree lights up to 13 volts are sometimes wired in parallel from such a transformer to avoid the trouble of having all of the usual series string go out when one of them burns out or breaks. There are some combined transformer and lamp sets on the market that are especially suited for economical use as low-voltage night lights; these have the outfit connected to the ordinary 115-volt circuit and the transformer forming the base or other part of the lamp steps the voltage down to 5 or so volts. For permanent service such an outfit is certainly preferable to a makeshift use of bell wiring and a toy transformer; the latter would not be recommended by me for lamp service except in small, emergency and temporary installations or for small signal lights.—H. T. M., Indianapolis, Ind.

No. 469.—LENGTH OF MOTOR BRANCH LINE.—What limit, if any, is there to the length of a tap line from a No. 0000 feeder to an autostarter for a 2300-volt motor? The tap line is to be No. 6 or No. 8 lead-covered cable run in conduit.—A. S. N., Plymouth, Mass.

If the size and type of the motor and the allowable percentage volt drop were given, the length of the branch could be stated. For ordinary short-distance wiring, such as one finds in the average shop, No. 8 wire would serve for a 75-hp., three-phase, 2300-volt, 60-cycle motor and No. 6 for a similar 100-hp. motor. If the motor is a 75-hp. machine and No. 8 wire is used, the branch can be run up to nearly 8000 ft. without exceeding a voltage drop of 5% on a 2300-volt supply.—A. W. S., Youngstown, Ohio.

No. 470.—PULLING IN LEAD-COVERED CABLE.—I would like information in regard to pulling lead-covered cable into iron conduit. What kinds and sizes of grips are suitable for use in pulling No. 0000 triple-conductor, lead cable of 2-in. outer diameter into 2½-in. conduit? Through how long a run and around how many elbows is it safe to pull this? I should like similar information regarding other cable sizes down to ¾-in. in diameter.—A. S. N., Plymouth, Mass.

Answer A.—A 2-in. Gem grip would answer the purpose, but in the absence of such a grip I would use a home-made hitch made of pieces of No. 15 iron wire wound about and lapped over each other to form a sort of laced loop at the end of the cable. If the runs are long, would use elbows very sparingly or make them of very large radius. Junction boxes would be preferable to use in this case, and in underground work manholes. Facilities for actually pulling in a heavy cable like this and supply of proper tools must also be considered.—J. H. L., North Cambridge, Mass.

Answer B.—This subject was discussed in three illustrated articles by Terrell Croft, entitled "Attaching Conductors to Fishing Wires and Pulling-in Lines," that appeared in the ELECTRICAL REVIEW of Jan. 11, 18 and 25, 1919.—Editor.

NEW YORK TELEPHONE CONSTRUCTION PROGRAM.

The New York Telephone Co., which operates the telephone exchanges in New York City, reports that the increase in local calls since the armistice was signed is unprecedented. To relieve the traffic load, the company is carrying on a construction program that will involve the expenditure of $20,000,000 within the city during the coming year. This expenditure will provide the equipment necessary to catch up with the requirement of traffic. The rate of expansion of traffic is indicated by the fact that company is adding girls to its staff of operators at the rate of 125 per week.

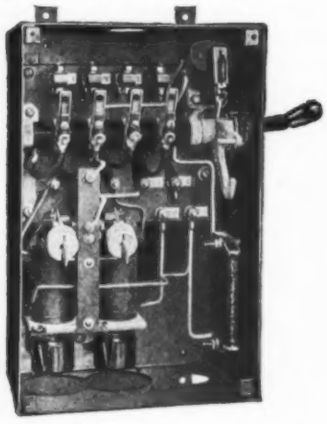
New Appliances

Motor-Starter Developments—Vaporproof Reflector—New D. C. Motors—Solderless Connector—Semi-Portal Crane

Two Enclosed Motor Starters with Overload Relay and Starting Resistor.

A starter with inverse-time-limit overload protection for squirrel-cage motors and a standard induction motor switch with a starting resistor, both having important operating safety features, are now manufactured by the Cutler-Hammer Manufacturing Co., Milwaukee, Wis., and known as Bulletins 9117 and 9118, respectively.

The Bulletin 9117 starter has, besides a low-voltage release, a duplex time-limit overload relay which is a complete unit in itself. The design of this overload movement is such that it does not open the circuit of the low-voltage coil on a high initial inrush of current nor on a momentary overload, but it will not permit a harmful overload to be maintained. This condition is obtained by retarding two moving plungers in oil dashpots. The plungers, which are actuated by two operating coils, trip a single contact-making device, thus opening the motor circuit. At the same time the

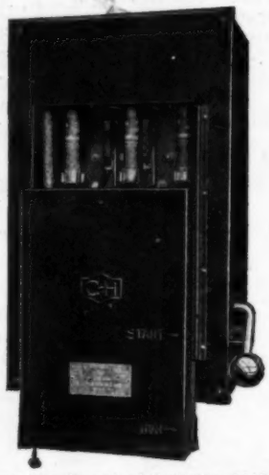


Bulletin 9117 Starter with Front Cover Removed, Showing Contactors, Duplex Relay and Low-Voltage Coil.

force of each plunger must overcome an adjustable weight which may be set at various positions along a lever arm, depending upon the amount of current desired to operate the plunger. By turning an adjusting screw the flow of oil around the plunger head may be regulated, thereby changing the time required for the relay to operate on any given overload condition. A coil, plunger, lever and weight are provided for each of two phases.

To start the motor, the operator moves the starter handle to the "up" position. This connects the motor to the line and brings into position an interlock which prevents opening the cover of the case. To stop, the operator simply moves the lever back to the stop position, which opens the circuit with a quick break and removes the interlocking bar. The starter is made with either three or four poles for use with standard squirrel-cage motors from 3 to 15 hp., and with high-torque motors of the "internal starter" type from 7½ to 25 hp. where the line voltage does not exceed 550 volts.

The starter known as Bulletin 9118 is essentially a modification of the en-



Lowering the Panel of Bulletin 9118 Starter Makes Fuses Dead and Accessible for Renewal—Switch Cannot Be Closed While Panel Is Lowered.

closed polyphase motor starter, Bulletin 9116, a description of which has already appeared in these pages. This starter is adapted for those motors which cannot be connected directly to the line without resulting in a dangerously large starting current. One step of resistance is provided in each of three phases during starting, allowing the motor 60% line voltage and an inrush of approximately three times full-load current. By using another set of terminals the resistor is decreased to give approximately 75% line voltage, and 3½ to 4 times normal current. The low-voltage protection coil automatically returns the switch to the "off" position upon failure of voltage.

The motor is started by raising the handle to the starting position which closes the switch. The handle is held here until the motor has reached full speed. Releasing the handle causes the switch contacts to slide into the running contacts, without opening the motor circuit. The fuses are not in the motor circuit until the switch is in the running position. Therefore, they do not carry the large starting current, and need be of no greater capacity than proper protection demands. This starter is designed for starting standard polyphase squirrel-cage motors of from 1 to 10 hp. on any commercial voltage not exceeding 550 volts. The starter can be furnished with resistors suitable for two-phase four-wire circuits, in which case an additional knife switch is required to entirely disconnect the motor.

Both types of starters are completely enclosed and are so designed that it is impossible to touch any live parts either while operating or while renewing fuses and making adjustments. Contact posts and fingers are of standard C-H construction used in the heavy drum controller, easily inspected and renewed. The enclosing cases are arranged for conduit wiring.

Vaporproof Prismatic Reflector Globe.

In the past all vaporproof lighting fittings have been equipped with clear glass globes and in order to obtain an efficient and glare-free lighting unit it has been necessary to place a reflector over the glass globe and a diffuser around the globe.

The Holophane Co., 340 Madison avenue, New York City, has designed a combined vaporproof globe and reflector by using the well-known Holophane

Holophane Vaporproof Reflector Globe.

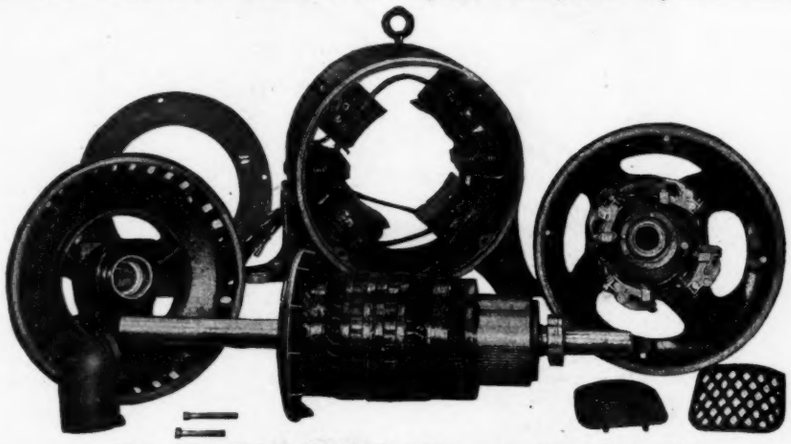
prismatic construction. The reflecting prisms are on the upper portion of the globe to redirect the light in downward directions and the refracting and diffusing prisms are on the lower surface to distribute the light in different directions in the desired proportions so that the resulting illumination on the work will be uniform.

Tests show that the useful illumination is increased by 75 per cent over that given by an ordinary clear vaporproof globe.

These vaporproof reflector globes are made for the 40 and 60-watt Mazda type B lamps and for the 75, 100 and 150-watt type C lamps for use in connection with the standard vaporproof fittings now on the market, including the navy thread.

A New Line of Direct-Current Motors Developed by Allis-Chalmers.

In the new line of commutating-pole direct-current motors and generators which has just been introduced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., the machines are not only rugged and compact, with excellent operating characteristics, but the many details which contribute to accessibility, reliability and safety have been thoroughly worked out. Commutating-pole construction was chosen because of its sparkless operation and possibility of getting wide speed adjustment.



Type "E," 25-hp., 230-Watt, 1150-r. p. m. Motor Dismantled.

This line includes the following standard ratings:

(1) Continuous rated (50° C. rise) motors, for applications where the power requirements are definitely known.

(2) Normal rated (40° C. rise) general purpose motors.

(3) Adjustable-speed motors for continuous or intermittent service.

(4) Generators and exciters.

For constant-speed motors the ratings and speeds are the same as those of 60-cycle induction motors, and they can thus be used interchangeably with induction motors for direct-connected applications without changing the method of drive or the ratio of gearing.

Adjustable-speed motors, intended particularly for machine tool and similar applications, are provided for 2:1, 3:1 or 4:1 speed range.

The generator speeds also correspond to those of induction motors, thus permitting direct coupling of the machines to form motor-generator sets in various combinations.

The line of ratings now complete covers motors from ½ to 50 hp. and generators from ½ to 40 kw., while larger sizes are under development.

Cast-steel yokes, combining light weight and rigid construction, are used for the larger ratings while the smaller machines, which are of the bipolar type, have riveted frames.

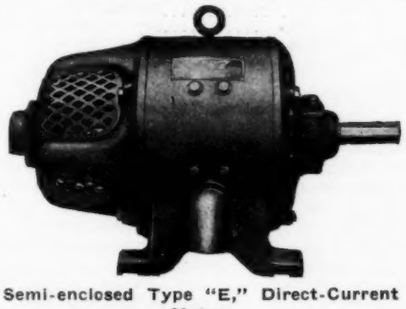
The accessibility of the commutator is apparent from the accompanying illustrations. Protecting grid covers can be provided for these openings in the front bearing bracket; they are readily attached and may be applied even to machines in service without affecting the rating. Solid covers are used with completely enclosed motors, the rating of these machines being somewhat lower than open or semi-enclosed motors.

All machines have ring oiling dust-proof bearings, while the windings are treated to resist oil and moisture. Conduit terminal boxes of simple design are regularly supplied; they have removable covers, givng ready access to the terminals; these boxes serve admirably in protecting the terminals and connections.

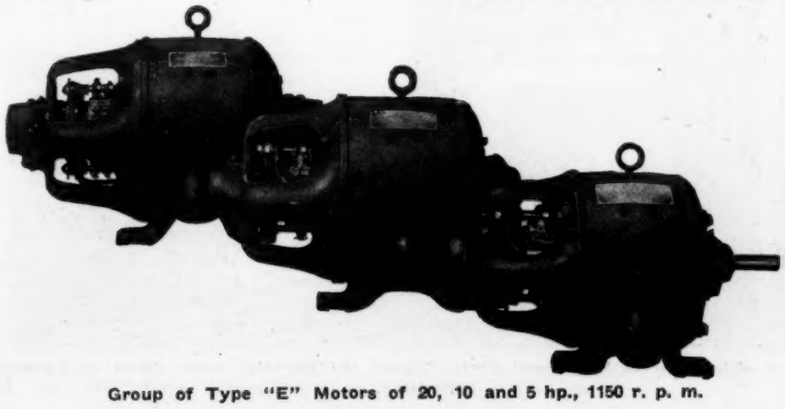
Box-type brush holders are adjustable for tension and suitable for either direction of rotation. Each holder can be removed independently with a screwdriver or wrench. At least two brushes per stud are used.

The field coils are wound on metal spools, which prevent any movement of the coils, and are protected by an outside layer of enameled wire.

The armature core has the laminations riveted together, permitting the removal of the shaft without dismantling the core or commutator, while for ratings of 20 hp., 850 r.p.m., and larger the core and commutator are built on a sleeve, so that the shaft can be pressed out of the finished armature without disturbing the windings.



Semi-enclosed Type "E," Direct-Current Motor.



Group of Type "E" Motors of 20, 10 and 5 hp., 1150 r. p. m.

An important feature of the machines is the very thorough ventilating system which has been provided, the heated air being drawn out by the fan mounted on the rear armature head; fresh cool air flows in through the liberal ventilating ducts and takes up the heat from the iron and windings. This heated air is forced out through openings in the periphery of the rear bearing bracket. With thorough ventilation the internal temperatures are kept low thus greatly prolonging the life of the insulation.

This new line, which is designed as the Allis-Chalmers type "E," is completely new throughout, no attempt having been made to re-design old apparatus or to employ parts from any previous machines. The motors are designed for belted as well as direct-connected applications and are particularly suited to the exacting requirements of machine tool service.

Sherman Solderless Fixture Connectors.

One of the best established rules in electrical installation work requires wire splices or joints to be made both mechanically and electrically secure without solder, and then they must be soldered unless made with some *approved* splicing device. Several such devices are now available on the market, a recently developed one with unique features being the Sherman fixture connector made by the H. B. Sherman Manufacturing Co., Battle Creek, Mich. As shown in the accompanying views, it is of very simple and effective design. It is made entirely of heavy brass to give high conductivity and freedom from danger of corrosion and consists of only three parts. The body or sleeve is of rectangular section with a depression in the upper side between the two screws forming a sort of bridge or dividing wall in the middle of the wire channel. This makes a definite place for each wire and insures that the end will be clamped by the proper screw. These screws are made of one piece each, the inner end being enlarged to give an unusually large bearing and contact surface and also to prevent the screw from dropping out.

Side and End View of Sherman Fixture Connector.

It will be observed that this construc-

tion has several important advantages. The screws are always in place and ready for use and they have a large thread that is not likely to get crossed. Thus no time is lost in looking for screws or in driving them home. No connectors need be discarded because of missing screws. The connectors are of durable make and can be used to join any fixture or lighting wires up to No. 12 in size. Two No. 12 solid wires can be accommodated at either end or three No. 14 wires. From this brief description it is evident that the Sherman connectors have all the usual advantages of good solderless connectors with the additonal features noted; also their cost is low.

Electric Semi-Portal Hoist Cranes at Boston Army Supply Base.

The Wellman-Seaver-Morgan Co. is now installing four semi-portal bridge-type hoist cranes at the U. S. Army Supply Base, Boston. The first of these cranes is in operation and is shown in the accompanying illustration, Fig. 1.

This crane carries a lifting boom operated from a carriage, which in turn is mounted on a semi-portal bridge, and arranged to rotate about a fixed axis. The bridge runs on two rails, one located near the face of the wharf, and the other supported on brackets carried on the side of the wharf shed.

It will be seen that the crane has four distinct motions:

1. Bridge travel along the wharf;
2. Trolley slewing;
3. Boom hoisting and luffing;
4. Load hoisting.

All of these motions are under the control of the operator located in the cab on the rotating carriage.

The crane is designed so that another drum can be added and a 2-rope grab bucket operated. The crane is rated to handle 8000 lbs. at a distance of 29 ft. from the face of the capsill at the rate of 200 ft. per min., and 500 lbs. at a distance of 52 ft. at 250 ft. per min. It will, however, take care of occasional loads of 8000 lbs. at 52 ft. from the center of rotation without any undue stress in any part of the crane.

The principal dimensions of the crane are as follows:

Horizontal span, center to center of runway rails	26 ft. 5 in.
Maximum reach of boom from face to capsill	44 ft.
Minimum radius of boom	29 ft.
Angle through which boom may be slewed	360°
Concrete counterweight required, about	3 cu. yds.

Speed.—The various motions of the crane have approximately the following speeds under full load:

Hoist 5000 lbs.	250 ft. per min.
Hoist 8000 lbs.	200 ft. per min.
Boom hoisting or luffing	125 ft. per min.
Slewing with 5000 lbs. load at maximum radius.	2 rotations per min.
Bridge travel along wharf.	200 ft. per min.

The different mechanisms are so arranged that the motion of either hoisting or luffing can be operated simultaneously with both rotating and traveling motions.

Bridge Structure.—The semi-portal bridge supporting the operating mechanism was designed in accordance with the "General Specifications for Steel Railway Bridges" issued by the American Railway Engineering Association in 1910, 100% being added to all live loads to allow for impact. In designing this structure, ample allowance was made for the swaying of the load. To the deck of the semi-portal is bolted a steel casting for supporting the revolving superstructure. This casting has a track plate, and bolted to the outside, a circular rack for the slewing motion. Concentric with this casting is a hollow center pivot pin, the lower end of which is securely held by cross-framing between the main girders of the semi-portal. A portion of deck not covered by the casting is covered with Diamond pattern steel plate. Hand railings are provided along the sides and outside edges of the deck, and a steel ladder is attached to one of the legs to give access from the wharf.

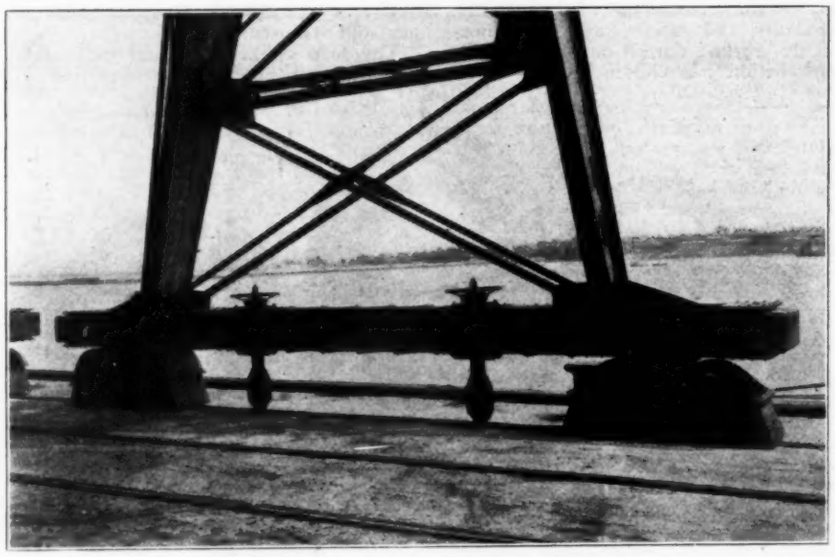


Fig. 2.—View of Trucks and Rail Clamps.

Wheels.—Each leg on the wharf side is carried on two wheels (as shown in Fig. 2) which are driven through the necessary spur and bevel gearing by the traveling motor. Each pair of wheels is equalized for the proper distribution of load. On the shed rail, the frame is supported by two wheels, one at each corner. These track wheels are double-flanged, high-carbon, cast steel, of ample size to carry maximum load and accurately finished to the diameter. The flanges of the wheels running on the shed rails are placed to give about a 7-in. tread. Wheels running on the wharf rail have the flanges spaced to allow proper clearance for the head of the rail upon which they run. All track wheels are forced on steel pins of ample size arranged to rotate in Hyatt roller bearings carried by the truck brackets.

Base Frame and Rollers.—The base frame is made up of rolled-steel shapes and plates well braced in all directions. The revolving superstructure is carried on six steel rollers or wheels, four in front where the heaviest load occurs, and two on the back. The front rollers are carried in a pair of steel equalizers. These rollers or wheels are of steel of ample size arranged to rotate on Hyatt roller bearings and placed so as to properly run on a circular track of about 5-ft.

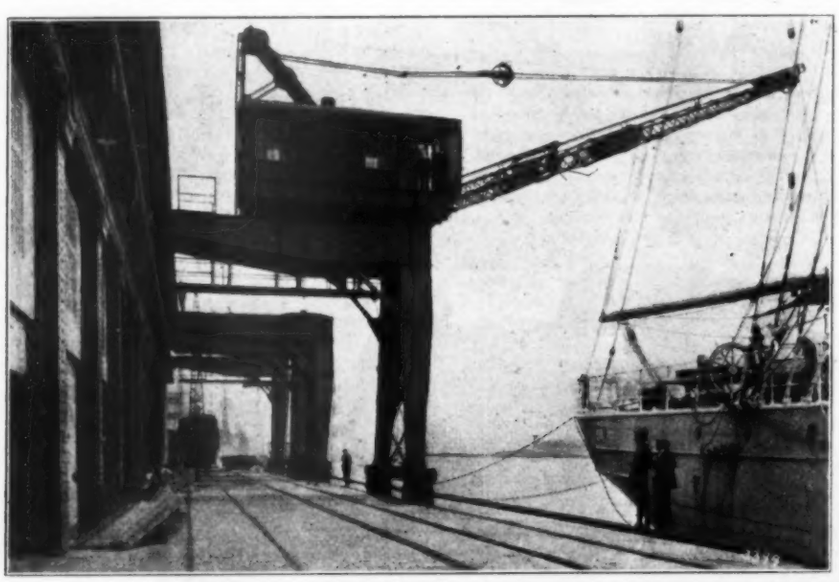


Fig. 1.—The First of Four Semi-Portal Cranes in Operation with Boom in Lowest Position.

radius about a pivot pin. A babbitted casting free to rotate about the center pivot pins is attached to the base frame to hold the crane concentric with the center pivot pin and to transmit longitudinal and overturning loads from the revolving superstructure to the semi-portal.

Pivot Pins.—The center pivot pin is made of a hollow steel casting to permit the threading of conductors through its center to the collector rings on top. The crane is designed so that under normal

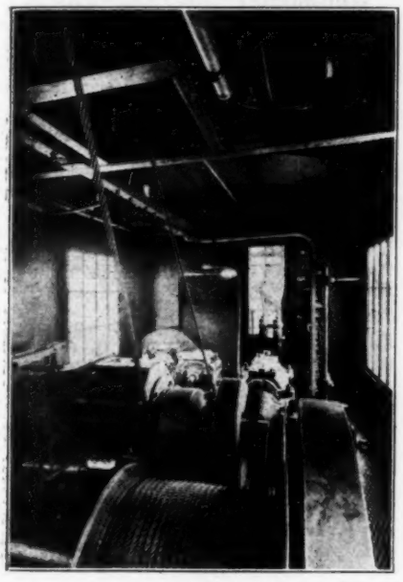


Fig. 3.—Inside of Machinery Section of Cab.

operating conditions, with a 5000-lb. hook load at the maximum radius, no appreciable load will be thrown on the center pin. It is, however, designed to transmit any possible vertical or horizontal load from the revolving jib crane to the semi-portal bridge without cramping or binding in any part.

Jib and Main Frame.—The jib and main frame is made of steel plates and shapes well stiffened in all directions. The frame is designed to support the jib, counterweight, machinery, electrical equipment and operator's house. A steel ladder is provided on the jib to provide access to the sheaves and other parts.

Counterweight.—The counterweight is made of concrete blocks in such shapes and sizes that they can be readily handled in case it is desired to dismantle the crane.

Cab.—The cab is composed of a steel framework covered with sheet steel. It contains the main part of the hoisting, luffing and rotating mechanisms. The control of all motions is so located that the operator has an unobstructed view of the load at all times. Figs. 3 and 4 show the interior of the cab.

Hoisting Mechanism.—The hoisting and lowering mechanism includes a winding drum, driven through a jaw clutch and a train of spur gearing by a motor equipped with a solenoid brake and necessary control apparatus and miscellaneous parts.

Luffing Mechanism.—The luffing of the boom is accomplished by a worm-driven drum operated by the hoisting motor through a jaw clutch and gearing so arranged that the boom can be raised or lowered at the convenience of the operator. The pitch of the worm is such that no mechanical brakes are required to prevent the load from lowering; but, as an additional safety, a pawl is provided to lock the luffing drum in any desired position.

Slewing Mechanism.—The slewing is accomplished by means of a motor operated through a train of spur and bevel gearing and a pinion meshing with the master gear attached to the semi-portal bridge. A powerful foot brake is provided on this mechanism having a latch, by means of which the brake can be locked for any desired fixed position of the revolving superstructure.

Traveling Mechanism.—A motor for traveling the bridge is mounted on one of the girders of the semi-portal bridge. This motor is connected to the driven track wheels through spur and bevel gearing and line shafting. One truck on the wharf rail is driven and one wheel on the shed rail. A solenoid brake is mounted on the armature shaft extension. Control apparatus for traveling is located in the operator's house. Electrical connections between the conductors on the semi-portal bridge and on the revolving superstructure are made through collector rings mounted on the center pivot pin or an extension of same. In addition to the solenoid brake, hand-operated rail clamps (shown in Fig. 2) are provided which clamp the wharf rail to hold the bridge in any fixed position.

Winding Drum.—The winding drum for hoisting mechanism is made of cast iron with turned grooves to fit the rope.

Electrical Equipment.—The electrical equipment is designed for direct current, 230 volts. The motors, controllers and magnetic brakes are General Electric Co.'s standard make. The motors are of the following rating:

1. Main hoist and luffing.....one 65 hp.
2. Slewing .....one 15 hp.
3. Bridge travel .....one 24 hp.

The controller for the hoist and luffing motor is of the reversing magnetic switch, dynamic-braking type, consisting of a control panel, heavy-duty, cast-grid resistor and a vertical-handle master controller.

In connection with the clutch-shifting lever which engages the hoist and luffing gearings with the driving motor, there is an interlocking switch mechanically operated. When the clutch-shifting lever is in central or neutral position, with both clutches disengaged, this switch prevents the operation of the motor. In other words, the function of this switch is to prevent the starting of the hoist motor without any load.

The slewing motor is controlled by a magnetic-switch reversing and plugging controller, consisting of a control panel, heavy-duty cast-grid resistor and a vertical-handle master controller. The plugging feature incorporated allows the motor to be reversed from full speed in one direction to full speed in the opposite direction without exerting over approximately 180% full-load torque.

The bridge-motor control is of the magnetic-switch reversing type with shunted armature points and consists of a control panel, heavy-duty cast-grid resistor and a vertical-handle master controller. The armature shunting points allow slow bridge speeds and also permit accurate control in case a favorable wind may help the motor in traveling, which would ordinarily give an excessive speed.

All of the above controllers are equipped with series relays for accelerating motors.

Safety Devices.—Ample provision is made for the protection of workmen. Guards extending down close to the rails and forming part of the truck brackets are placed in front of the track wheels. All gears are enclosed. Ladders and platforms are provided for access to mechanical parts of the crane which are subject to inspection and repairs. Hand railings are provided around all platforms. Sheaves are provided

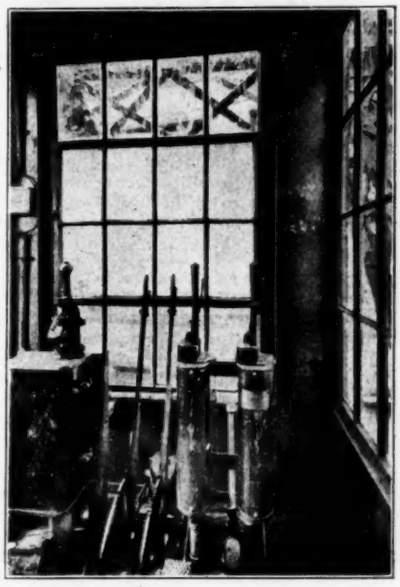


Fig. 4.—Inside of Operator's Part of Cab.

with tight-fitting guards where necessary. A limit switch is provided to prevent overtravel in the hoisting direction on the main hoist motion. A pressed-steel foot gong is provided in the operator's cab for signaling purposes. There is a mechanical gong on the bridge motion. This gong will ring continuously.

Bearings.—Hyatt roller bearings are used throughout the different motor-driven units.

Adaptable and Portable Electric Drill and Hammer Stand.

A portable stand to permit a safer, simpler and more economical method of using electric drills and hammers in overhead work has been placed on the market by the Hammerstand Manufacturing Co., 370 Pearl street, Brooklyn, N. Y. This device is for use in installation of electrical apparatus, pipe work, supports in concrete stone work and such location where the workman would ordinarily have to employ a ladder and scaffolding to support himself and his tools.

The hammer stand can be moved readily from place to place upon wheels. The drawing handle automatically raises the wheels off the ground when the tool is in position. Very light pressure applied to the lever keeps the drill hammer following the work. The operator stands on the floor while working. An attachment enables holes to be drilled in corners and other awkward places. The attachment is simply a rigid horizontal bar bolted to the top of the stand on one end and carrying the drill in the other.

Trade Activities

General Electrtc Exhibit at Chemical Exposition—Electric Furnace Installations—Western Electric to Erect New Plant

The Valentine-Clark Co., producer of cedar poles, having offices at Chicago, Minneapolis and Toledo, has lately established a western office in Peyton building, Spokane, Wash.

Page & Hill Co., Minneapolis, Minn., has greatly increased its facilities by the installation of a new 15-ton Browning locomotive crane. This crane will be used in handling cedar poles at the butt-treating plant and for loading cars at Minnesota Transfer.

Electric Furnace Construction Co., Finance building, Philadelphia, advises the receipt of an order from the Hammond Steel Co., Syracuse, N. Y., for one 3-ton furnace for the manufacture of high grade tool steels. A Greaves-Etchells furnace is also being installed for the Hong Kong Steel Foundry Co., China.

Western Electric Co., New York City, has purchased for a consideration of $190,103 55 acres of land, situated in Berkley, Norfolk, Va., from the St. Helena Corp., and within a few weeks will build shops on the site for the manufacture of submarine cables and other products. The land was formerly used by the Tunis Lumber Co., and fronts on the south branch of the Elizabeth river. It is believed that a large financial outlay will be involved in the establishment of the new shops and that 1000 or more employes will be given work. It has also been stated that in addition to the manufacture of cables, a large number of other electrical products will be made at the Berkley plant.

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has issued a new 8-page, 8½ by 11-in. booklet on "C-H Mine Duty Apparatus." This booklet makes special reference to the Cutler-Hammer mine duty apparatus installed in the plant of the St. Louis Smelting & Refining Co. at St. Francois, Mo. A detailed description of the method of handling the ore from the three levels of the mine until it is ready for shipment is given. Special emphasis is laid on the hoist and conveying machinery and the C-H automatic control and safety apparatus used on this machinery. The illustrations show the mine hoist control panel, master switches, limit switches, overspeed governors and electrically operated brakes; also the automatic starters for the crushers and conveyors. These starters are controlled from push-button stations and the speed of the conveyors and crusher is governed by armature regulators. The front and back covers of the booklet display a panoramic view of the buildings above the mine, including everything from man-hoist to chat dump.

The Detroit Electric Furnace Co. has sold to Oregon Brass Works, Portland, Ore., two Detroit electric rocking brass furnaces of 2000 and 1000-lb. charges, respectively. It is expected that the installation of the two furnaces will be completed in the next sixty days. The Oregon Brass Works, of which H. C. Prier is president and manager, has thus taken the initiative in equipping its brass foundry with the first electric furnaces in the Northwest, to better meet the demands for marine and structural bronze.

A. C. Mannweiler Co., Fort Wayne, Ind., manufacturer of miniature incandescent lamps, is illustrative of the remarkable growth of this industry, having within the brief period of its existence increased its output from 25 to 50 bulbs per day to the present daily output of 4000 lamps. This concern had its inception about six years ago, having as its president and founder Anthony C. Mannweiler, who prior to that time had had an extensive experience in the manufacture of incandescent lamps. The company, which began operations in very modest quarters, consisting of only one room, has grown to such generous proportions that today it ranks as one of the largest manufactories in Fort Wayne. The product of this organization has a wide range of application, being used extensively for flash lights, illuminating mines, for surgical instruments, automobile lights, boat lights, switchboards, etc.

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., is distributing Bulletin No. 1106 introducing the new Type "E" motors and generators. In developing this new line it has been the aim of the company to produce not only a rugged, serviceable motor, with superior operating characteristics, but also to incorporate the many details which contribute to reliability and safety. These machines are designed for belted as well as direct connected applications and particularly suited to the exacting requirements of machine tool service. Among the important features claimed for the Type "E" motors are: Ratings and speeds corresponding to standard 60-cycle induction motors; complete line of constant and adjustable speed ratings; rugged cast steel yokes; commutating poles, insuring sparkless commutation; dust-proof bearings; windings treated to resist oil and moisture; thorough ventilation; conduit terminal boxes on all motors; improved box type brush holders; standard enclosing covers; interchangeable parts, and accessibility of all parts, all of which are illustrated and described in detail in the bulletin.

Williamsport Wire Rope Co., Williamsport, Pa., manufacturer of wire rope, announces the establishment of its warehouses in Chicago at 753-55 West Quincy street, also a branch office at 122 South Michigan avenue, both under the management of C. M. Ballard. Every size and construction of wire rope, cut to any desired length, will be carried at the Chicago warehouse. The company through the establishment of this local branch will be enabled to give its customers better service than in the past.

Landers, Frary & Clark, New Britain, Conn., manufacturers of Universal electric heating and cooking devices, are erecting a new factory in the eastern part of Plainville, located on the bank of the Housatonic river, and it is expected that the new quarters will be ready for occupancy in about a month. The building, which is a four-story structure of fireproof construction, will be used as a celluloid plant. A power plant, which will furnish power and light for the new plant, has been erected on the bank of the river. The walls are of double brick thickness, with three or four set divisions throughout the entire building.

General Electric Co., Schenectady, N. Y., will exhibit at the Chemical Exposition, to be held at the Coliseum, Chicago, Sept. 22 to 27, a very interesting model of a precipitation outfit, illustrating the Cottrell process of precipitation. The model is the property of N. H. Gellert of the Gellert Engineering Co., which holds the precipitation patents as applies to blast furnaces. It was made by the General Electric Co., and is an exact miniature of the apparatus and is completely operative. Other apparatus exhibited by the General Electric Co., includes a KT-312-6-15 hp. 1200 r.p.m. 440-volt motor with frame and coils completely coated with an acid resisting insulation, which is particularly adapted for use in chemical and fertilizer plants. Two stater coils of this motor will be shown. Another feature will be an RC-25, 2-hp. 1150 r.p.m. 230-volt totally enclosed DS-2 shunt wound motor which is equipped with the new Argute plug bearings. A 100,000-volt Kenetrom with a filament heating transformer will be shown in operation. Of special interest will be an exhibit board, showing welded terminals for flexible cables used on blast furnaces. Chester T. McLoughlin of the power and mining department, Schenectady Works, will be in charge and will be assisted by Raymond Barclay, and several representatives from the Chicago office of the General Electric Co.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

Rutland, Vt.—In connection with the construction of the new plant of the Tauber-Lipton Co., work on which was commenced recently, contract has been awarded to the Rutland Railway Light & Power Co. for furnishing electric energy for light and power for the operation of the new works.

Cambridge, Mass.—Work has recently been commenced by Page & Shaw, 18 Ames street, on the construction of a power plant to be used for the operation of a six-story manufacturing works now in course of construction. The plant will be about 60x140 ft., and will be used for increased capacity. Considerable mechanical and electrical equipment will be required. The E. A. Abbot Construction Co., 3 Park street, Cambridge, is the contractor.

Bridgeport, Conn. — Bridgeport Brass Co. will build a one-story, 150 x220 ft. addition to its casting shop on Grand street. Electric power to operate crane will be installed. The estimated cost of the work is $150,000.

Albion, N. Y.—Board of Managers of the Western House of Refuge for Women has awarded a contract to the John W. Danforth Co., 70 Ellicott street, Buffalo, for extensions and improvements in the heating system at the institution, at $8187. Lewis F. Pilcher, Capitol Building, Albany, state architect.

Canandaigua, N. Y.—Lisk Manufacturing Co., 160 Fifth avenue, New York, has awarded a contract to Curren & Swartout, Granite building, Rochester, for the construction of a one-story power plant at its local properties, about 63x87 ft.

Geneva, N. Y.—O'Malley Motor Co. plans the erection of a three-story, 50x100 ft. machine shop, garage and service station, on Canal and Exchange streets. Transmission and electric power will be installed. Estimated cost, $50,000.

Long Island City, N. Y.—Large quantities of electrical and mechanical equipment will be required in connection with the construction of the proposed plant of the American Trunk Co., to be located at Thompson, Mound Markey streets and Mott avenue, preliminary work on which was inaugurated recently. The entire new works are estimated to cost in excess of $1,000,000.

Long Island City, N. Y.—In connection with the construction of the six-story and basement plant of S. Karpen & Brothers, 68 West 34th street, New York, on Jackson avenue, near Hulst and Harold avenues, Long Island City, large quantities of electrical and mechanical equipment will be required. The new plant, contracts for which have been awarded, is estimated to cost $725,000.

New York, N. Y.—Contract has been awarded by the Fulton Laundry, 312 East 92nd street, for alterations and improvements in the boiler plant at its property, to facilitate operations.

New York, N. Y.—Announcement has been made by the Commercial Cable Co., 20 Broad street, of a reduction in commercial cable rates from all parts of the United States, the Philippines and China of 22 and 20 cts. per word, respectively, effectice Sept. 1.

New York, N. Y.—Following the purchase of the Chesebrough building by Henry L. Doherty & Co., 60 Wall street, negotiations have been completed for the acquirement of the Battery Park and Maritime buildings on State street, located between Pearl and Bridge streets, held by the same interests formerly controlling the Chesebrough structure. The entire consideration for the three buildings is said to be approximately $5,000,000.

Syracuse, N. Y.—U. S. Hoffman Co., 329 Temple street, is making rapid progress on the construction of its one-story building at Taylor and Oneida streets. The structure will be about 80x195 ft., and is estimated to cost $23,000.

Talcville, N. Y.—St. Lawrence Transmission Co., which has purchased the rights of A. J. McDonald in the Freeman Talc Mines, plans extensive improvements and the installation of crushing and conveying machinery and electrically driven units. Estimated cost of improvements, $60,000.

Boonton, N. J.—Eastern Signal & Supply Co., 30 Church street, New York, has rented property in a local building covering about 5000 sq. ft. of floor space for a new establishment. The company specializes in the manufacture of primary storage batteries.

Camden, N. J.—American Ice Co., Philadelphia, Pa., is having plans prepared for the construction of a new brick and concrete ice plant at 12th and Federal streets, Camden.

Dover, N. J.—Contract has been awarded to the Jersey Corp. by the Paige & Jones Chemical Co. for furnishing electric energy for light and power purposes for the operation of the new plant to be established at Boonton.

Harrison, N. J.—Driver-Harris Co., Middlesex street, manufacturer of electric wires, cables, etc., has had plans prepared for the construction of a new three-story reinforced concrete structure at its plant, about 50 x100 ft. The building is estimated to cost $50,000. Lockwood, Greene & Co., 103 Park avenue, New York, are engineers.

Lambertville, N. J.—Lambertville Public Service Co. has inaugurated preliminary work for the construction of a new high-tension transmission line from Lambertville to Flemington for improved electric service, and new generating equipment is being installed in the local power plant. At the present time the company has under way the construction of a similar transmission line between Netcong, Morris county, and Newton, Sussex county, passing through Stanhope and Andover. Harold R. Wilbur is local manager.

Newark, N. J.—American Transformer Co., 178 Emmett street, has filed plans for alterations and improvements in its local plant to facilitate operations. The work is estimated to cost about $5700.

Perth Amboy, N. J. — Lighting Committee of Board of Aldermen has under consideration plans for the installation of electrical machinery in the municipal light and power plant.

Pompton Lakes, N. J.—Tri-County Electric Co. has been granted a franchise by the Borough Council, Wanaque, for furnishing electricity for lighting and power service to the borough. The company purchases electric energy from the municipal power plant at Pompton Lakes.

Trenton, N. J.—Fire on Sept. 1, seriously damaged one of the large dynamos at the power plant of the Trenton & Mercer County Traction Co., on Lincoln avenue. It is understood that the company will make repairs immediately.

Trenton, N. J.—City Commission has completed plans for the installation of considerable new electrical and hydraulic apparatus at the city pumping station on Calhoun street. An appropriation of $150,000 was authorized some time ago to cover the cost of the improvement, but owing to war conditions the work has been delayed. It is proposed to proceed with the installation at once.

Trenton, N. J.—Trenton Malleable Iron Works, New York avenue, have had plans prepared for the construction of a new one-story power plant and boiler house, of brick and concrete construction, to be used for works operation. R. A. Schuman, 923 Lexington street, Trenton, is architect.

Trenton, N. J.—Hearnen Storage Battery Co. has completed negotiations for the purchase of the plant and property of the Charles W.

Carll Co., at West Front and South Warren streets, for a new establishment.

Allentown, Pa.—City Council has recently inaugurated tests in the new electric street lighting system installed in various thoroughfares of the city.

Bolivar, Pa.—It is reported that Bolivar has under consideration the installation of an electric light plant.

Harrisburg, Pa.—Harley D. Carpenter, Crawford county, has filed application with the Public Service Commission for approval of contracts to furnish electric energy for lighting service, etc., to Cochranton Borough and the townships of North, West and South Shenango, and East and West Fallowfield.

Philadelphia, Pa.—American Ice Co., Sixth and Arch streets, is having plans prepared for the erection of a new plant at Mascher street and Ducannon avenue, in the Olney section. It is planned to use a portion of the building for manufacturing and another section for storage purposes. Walter Lee is vice-president.

Philadelphia, Pa.—Electric Storage Battery Co. has awarded a contract to the William Steele & Sons Co., 1600 Arch street, for the construction of a new one-story brick addition to its plant at 19th and Willard streets. The structure will be about 32x97 ft., estimated to cost $14,000 and will be used for increased operations.

Philadelphia, Pa.—Caledonian Dye Works, Cornwall and Emerald streets, have awarded a contract for the construction of a new boiler plant at their works, about 18x22 ft., for increased operations. The structure is estimated to cost $14,000. J. K. Petty & Co., Stephen Girard building, are the contractors.

Philadelphia, Pa. — Pennsylvania Salt Manufacturing Co., Widener building, has had plans prepared for alterations and improvements in the boiler plant at its works at Delaware avenue and Porter street, estimated to cost $5000.

Pottsville, Pa. — Philadelphia & Reading Railroad is understood to be considering plans for the electrification of the Pottsville and Mill Creek Junction section of its system this fall.

Titusville, Pa.—Titusville Light & Power Co. has filed notice with the Public Service Commission of the operation of a new schedule of increased rates for service, effective Sept. 1.

Wilkes-Barre, Pa.—Guaranty Silk Co. is taking bids for the erection of the proposed power plant at its works to be used for general factory operation. Reese D. Isaacs, Anthracite building, is architect for the company.

Huntington, W. Va.—The secretary of state has issued a charter to the Electric Unit Corp., of Huntington, with a capital of $50,000 for the purpose of carrying on a general electrical buisness in Huntington. Incorporators: C. C. Hartzell, H. T. Lovett and others.

DATES AHEAD.

Association of Edison Illuminating Companies. Annual meeting, New London, Conn., Sept. 16-18. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

Southeastern Section, N. E. L. A. Annual convention, Asheville, N. C., Sept. 17-19. Secretary-treasurer, T. W. Peters, Columbus, Ga.

Iowa State Association of Electrical Contractors and Dealers. Annual convention, Sioux City, Iowa, Sept. 22 and 23. Secretary, F. Bernick, Jr., Oskaloosa, Iowa.

New England Section, N. E. L. A. Annual convention, New London, Conn., Sept. 22-24. Headquarters, Hotel Griswold. Secretary, Miss O. A. Bursiel, Boston, Mass.

Association of Iron and Steel Electrical Engineers. Annual convention, St. Louis, Mo., Sept. 22-26. Secretary, John F. Kelly, Empire building, Pittsburgh, Pa.

American Electrochemical Society. Fall meeting, Chicago, Sept. 23-26. Headquarters, Congress Hotel. Secretary, Prof. Joseph W. Richards, Lehigh University, Bethlehem, Pa.

International Association of Municipal Electricians. Annual convention, Chicago, Sept. 23-26. Secretary, Clarence R. George, Houston, Tex.

Northwest Electric Light and Power Association. Annual convention, Seattle, Wash., Sept. 24-27. Secretary-treasurer, George L. Myers, Portland, Ore.

Empire State Gas and Electric Association. Annual meeting, New York City, Oct. 9. Secretary, Charles H. B. Chapin, 29 West 39th street, New York City.

National Association of Electrical Inspectors. Annual meeting, Springfield, Mass., Oct. 13 and 14. Secretary, W. L. Smith, Concord, Mass.

Illuminating Engineering Society. Annual convention, Chicago, Ill., Oct. 20-23. General secretary, Clarence L. Law, 29 West 39th street, New York City.

Illinois State Electric Association. Annual convention, Chicago, Oct. 22 and 23. Secretary-treasurer, R. V. Prather, Springfield, Ill.

American Society of Mechanical Engineers. Annual meeting, New York City, Dec. 2-5. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

Black Mountain, N. C.—J. S. Kuykendall, Winston-Salem, N. C., has prepared plans to furnish electric power.

Homestead, Fla.—An election will be held Sept. 23 upon the issuance of $12,000 bonds for doubling the capacity of the electric light plant. Address the mayor.

Savannah, Ga.—City of Savannah has taken options on 1600 acres of land, with 2500 ft. frontage on the Savannah river, with a view of developing a municipally owned and operated terminal and wharves. The plan involves about $200,000 initial consideration, which will later be expanded to an outlay of practically $5,000,000.

NORTH CENTRAL STATES.

Alliance, Ohio.—Architect Wade Steidler, City Hall, has prepared plans for $525,000 gas producing station to be erected by city. The building will be brick construction, steam heating, plumbing, electric lighting.

Dayton, Ohio.—Gem City Ice Cream Co., 1005 West Third street, plans to enlarge its plant and will install a 180-ton Hardwick ice machine and new electric motors.

Kent, Ohio. — Ohio Machine & Tool Co., Canton, Ohio, will erect a factory addition. The building will be 40x80 ft. in dimensions, brick and reinforced concrete construction, steam heating, plumbing, fireproof interior finish, boilers and pumps, electric lighting. Estimated cost $75,000.

La Grange, Ohio.—$20,000 in bonds have been authorized for electric light system. C. S. Adams.

Bluffton, Ind.—H. C. Bay Piano Co. will erect a three-story office building and salesroom. The main office of the company will be removed from Chicago to Bluffton. The company is now operating a plant in Bluffton employing 650 men.

East Chicago, Ind.—Fire has destroyed the west part of the General American Tank Corp. plant, with loss estimated at $300,000. The burned buildings include the brass foundry, car shop and insulating shop. The newer part, which is of metal construction, was saved.

Greenfield, Ind. — Charlottesville Electric, Heat & Power Co. has been incorporated to establish a plant for the town of Charlottesville.

Indianapolis, Ind.—Extensive improvements are planned by the Interstate Public Service Co., which operates the electric traction line between Indianapolis and Louisville. The company plans the expenditure of approximately $350,000 which will make the line between the two cities one of the best equipped in the Central West.

Chicago, Ill.—William R. Johnston Manufacturing Co. has purchased property on Crawford avenue, Schubert avenue, between Fullerton and Wrightwood avenues, having a frontage of 150 ft. and depth of 750 ft., and contains an aggregate of about 100,000 sq. ft. As soon as building conditions warrant, the company will erect a modern building, having about 50,000 sq. ft. of floor space, to cost about $100,000.

Hawthorne, Ill.—A $5,000,000 addition to the present Hawthorne plant of the Western Electric Co. is contemplated. The addition is needed on account of the steady growth of the business.

Medora, Ill.—An election will be held to vote on the issuance of $12,000 light and power bonds. Address city clerk.

Springfield, Ill.—An election will be held Nov. to vote on the issuance of bonds to the amount of $400,000 to extend the electric service to the entire city.

Springfield, Ill. — The property owners of Douglas avenue have petitioned for an extension of the ornamental lights. Address City Engineer Seeley.

Ecorse, Mich.—Village will soon let contracts for building elevated steel tank with capacity of 150,000 gal., two motor-driven centrifugal pumps, with capacity of 500 gal. per

minute, reinforced concrete reservoir, 500,000 gal. capacity, and 8000 ft. water pipe. Separate bids on steel tank and on remainder of job complete. R. A. Murdock, 706 Free Press building, Detroit, engineer.

Marquette, Mich.—City Commission has had plans prepared for the erection of a power plant. Plans call for a building of brick and steel, reinforced concrete construction, including steam heating. The specifications include electrical equipment. Contracts will be let by the city clerk.

Vassar, Mich. — The council is planning ways and means to improve the light and water system. Address village clerk.

Emmons, Minn.—Contracts have been let to Minnesota Gas & Electric Co., Albert Lea, for building a high-tension line from its central plant to Emmons for light and power.

Atlantic, Iowa.—The city is having plans prepared for a $26,000 addition to the power plant. Generators, pumps, motors, etc., will be purchased. Address city clerk.

Mason City, Iowa.—C. H. McNider and associates are planning the erection of an eight or nine-story hotel to cost with the site $650,000.

Tama, Iowa.—Contracts have been let to Blythe Brothers for grading of electric line to be built from Tama to Toledo. Address Perry Walters, Toledo, Iowa.

Bison, Kans.—A 6-mile transmission line will be built from Bison to La Crosse. D. M. Rothweeler, mayor.

Chanute, Kans.—A bond issue of $250,000 has been voted by the city to build water works and an electric light plant.

Hugoton, Kans.—The City Council is contemplating the erection of a new electric light and water plant.

Winfield, Kans.—Plans are being prepared for a $45,000 electric light plant. Address city clerk.

Mountain Grove, Mo.—J. Fred Ellis and L. H. Williams contemplate building a dam and power plant at Double Grove Spring near Dora. The plant will develop 1000 hp.

St. Joseph, Mo.—A turbine of 12,500-kv-a. capacity is being installed in the steam plant of the St. Joseph Railway, Light, Heat & Power Co. The entire plant is being remodeled and equipped for oil burning. The steam capacity of the plant will be increased by the installation of two 1000-hp. Bigelow Hornsby boilers, and two smoke stacks of 16 ft. and 12 ft. in diameter, each 260 ft. high.

SOUTH CENTRAL STATES.

Lexington, Miss.—The city will vote on the question of issuing $20,000 additional electric light system. W. L. Jordan, city clerk.

Starkville, Miss.—The city will issue $55,000 in bonds for water, electric system. Address mayor.

Springdale, Ark. — The city has voted to issue $200,000 in bonds for sewer and water system. J. S. Ewalt, mayor.

Chelsea, Okla.—The sum of $30,000 in bonds have been voted to erect light and water plant. Address mayor.

Enid, Okla.—Enid Pipe Line Co., owner of the line from the oil fields to the Enid refineries, decided to construct a new power plant. The plant will be located where the line turns west from the oil fields towards Enid. Houses for employes and other improvements will also be built.

Pawhuska, Okla.—The attorney general has approved the issuance of $67,000 electric light bonds. Address mayor.

Stroud, Okla. — City will vote bonds for a light and water plant. W. A. Hadley mayor.

Hearne, Tex.—The city will increase the capacity of the light and water plant 100%.

San Angelo, Tex.—San Angelo Water, Light & Power Co. contemplates the erection of a water filtration and purification plant to cost between $40,000 and $50,000.

WESTERN STATES.

Buhl, Idaho.—Idaho Power Co. will increase the generating power of its plant at Thousand Springs from 6000 to 8000 hp. Improvements will include the installation of gates and dredges. R. B. King, district manager.

Roosevelt, Ariz.—Salt River Valley Water Users Association, Phoenix, plans to erect a 5000-kw. steam generating plant for furnishing power to about 60 pumps, which will be used to lower underground water level. C. A. Van der Verr is secretary.

Yuma, Ariz.—Yuma Ice Co. has placed an order for transmission-line poles with R. E. Downie, Seattle.

Hardin, Mont.—The Hardin electric light and power plant is to be remodeled, new and larger steam boilers and engines and a new generator installed. As soon as the new equipment is ready, both day and night service will be given, instead of only night service, as at present.

Astoria, Ore.—Pacific Power & Light Co. has arranged for the purchase of a 15-acre tract on Young's Bay, as a site for a power plant, which is to be built at a cost of $750,000. It will comprise equipment for electric generation and the production of gas. The electric plant planned, it is estimated, will be of a capacity sufficient to supply all power and lighting demands in the lower Columbia river region.

Bandon, Ore.—The proposal to build a municipal electric power plant at Bandon is receiving the consideration of the mayor and council. A water-power site on Elk river is being investigated.

Princeville, Ore.—$150,000 in bonds have been voted to complete the municipal dam and power system.

Reedsport, Ore.—A $10,000 railroad spur which will serve four mills and one warehouse is planned by the firms concerned. Warren Reed, V. G. Hindmarsh and C. McJohnson are interested.

Everett, Wash.—The city commissioners have engaged Burns & McDonnell, Kansas City, to prepare and present data with the view of either buying or building a light, heat and power plant for the city.

Seattle, Wash.—An ordinance is before the council providing for an issue of $432,000 in bonds to be used in constructing electric road, building a saw mill and a temporary electric plant.

Seattle, Wash.—Mayor Fitzgerald has announced as the result of an inspection trip made by him to the Cedar river dam and the Cedar Falls power plant, bids will be called at once for the installation of a 10,000-kw. generator at the Cedar Falls plant and the new pipe line from the dam to the power house. Provision has been made for these extensions by the city council, utility bonds in the sum of $1,755,000 being available.

Spokane, Wash.—Universal Electric Co. will erect a building at 1218 Second street at a cost of $10,000.

Tacoma, Wash.—The city will install an Allis-Chalmers 1500-kv-a. 3-phase outdoor transformer, from which energy will be furnished for motor drive in the mills of St. Paul & Tacoma Lumber Co.

Fresno, Cal.—San Joaquin Light & Power Co. has ordered 7500 wood poles from R. E. Downie, Seattle, Wash.

Pasadena, Cal.—Warnerlite Co., Davenport, Iowa, manufacturer of lighting plants and electrical products for automobiles, will start within six months the construction of a $100,000 factory building in Pasadena. This building will be the first unit of a plant in Pasadena to manufacture products to supply the Pacific Coast and export trade of the company.

Sierra Madre, Cal.—Plans are under advisement for civic improvements, involving an expenditure of about $100,000, which will include extensions to waterworks, sewer systems and installation of ornamental street lamps.

CANADA.

Naramanta, B. C.—Town Council has awarded contract to K. Winger, Peachland, for the construction of power house.

St. John, N. B. — The Department of Public Works, Ottawa, Ont., has awarded contract for the construction of a coffer-dam at Courtenay Bay, at the entrance to the dry dock of Bedford Construction Co., Halifax and St. John. Two 12-in. electrically driven water pumps will be installed.

Forest, Ont.—The town plans to build a water works system to include electrically driven pumping equipment. James, Loudon & Hertzberg, Excelsior Life building, Toronto, engineers.

PROPOSALS

Centrifugal Pump.—Until Sept. 17 bids will be received by the purchasing agent of Kansas City, Mo., for furnishing pumping station with centrifugal type pump driven by steam turbine through reduction gears; centrifugal pump driven by vertical cross compound Corliss engine. W. C. Goodwin, engineer.

Lighting Plant and Distribution System.—Bids will be received by C. H. Bolland, town clerk, Tishomingo, Okla., until 8 p. m., Sept. 18, for the construction of a complete electric light plant and distribution system, consisting of a power house, two 75-kv-a. generators, direct connected to semi-Diesel oil engines, switchboards, 15,000 lbs. copper wire, 400 poles, line material, etc. Johnson & Benha, construction engineers, Firestone building, Kansas City, Mo.

Motor-Driven Pumping Plant.—Bids will be received Sept. 16 at the office of the country auditor at Wapello, Iowa, for furnishing all material, labor, tools and appliances and constructing as a part of the drainage system of the district a complete drainage pumping plant. Bids are desired upon several types of plants as follows: Steam-driven pumping plant, motor-driven pumping plant to operate on electric current furnished under another contract, oil engine pumping plant, combination plant with present plant. Address F. G. Wright, acting on behalf of drainage district No. 13.

Conduits and Wiring.—Bids will be opened in the office of the supervising architect, Treasury Department, Washington, D. C., at 3 p. m., Sept. 30, for furnishing the labor required in the construction, complete (including heating, plumbing, electric conduits, and wiring), with materials that will be furnished by the Government for senior medical officer's quarters, attendants' quarters, tuberculosis pavilion and approaches, for the United States marine hospital at Boston, Mass. Drawings and specifications may be obtained from the custodian, or at the above office, in the discretion of the supervising architect, James A. Wetmore, acting supervising architect.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number given.]

Pumps, Motors, Turbines, Etc. (30,552).—The representative of a firm in Spain is at present in the United States and wishes to secure an agency for the sale of electrical machinery, material for central generating stations, small electrical material, pumps, turbines, internal combustion motors, and lamps. References.

Electrical Supplies (30,556). — An agency is desired by a man in Italy for the sale of agricultural and general machinery, tools, metals, electrical supplies, cloth and yarn. Correspondence may be in English. References.

NEW PUBLICATIONS

Prices of Coal and Coke, 1913-1918, is a publication of 115 pages by C. E. Lesher, prepared in co-operation with the United States Fuel Administration and War Industries Board. This paper, which deals with the prices of domestic coal and coke from 1913 to 1918, inclusive, is one of 50 similar studies of war-time prices in different industries prepared by or at the request of the War Industries Board. The aim of these studies is both to make the price quotations gathered by various Government agencies available to men concerned with problems of business readjustment and also to provide a permanent record of the great revolution in prices that accompanied the World War. The report is one of the products of the joint efforts of the United States Fuel Administration and the United States Geological Survey, which during the war combined their statistical work on coal and coke. It is published as a chapter in the history of the Fuel Administration and as a part of the annual report on the mineral resources of the United States by the Geological Survey for 1918; it is also combined with reports on other commodities in the history of prices published by the War Industries Board.

Telegraphs — The Bureau of the Census, Department of Commerce, has issued a report on the census of telegraphs and municipal electric fire-alarm and police-patrol signaling systems for 1917. This report is a part of that on electrical industries which in its entirety covers telephones, electric light and power stations and street and electric railways, and covers 61 pages.

The Constitution and Metallography of Aluminum and Its Light Alloys with Copper and with Magnesium is the title of a new publication of the Bureau of Standards, Scientific Paper No. 337. This paper deals with the solubility-temperature curves of $CuAl_2$ and of Mg_4Al_3, and incitally with the solubility of $FeAl_3$ and the condition and solubility of silicon in aluminum. The solubility-tempertures curves were determined by the method of annealing and microscopic observation and it was found that aluminum dissolves about 4.2% of copper as $CuAl_2$ at 525° C and about 12.5% of magnesium as Mg_4Al_3 at 450° C. The solubility of both compounds decreases with decreasing temperature. Observations are made regarding the structural condition of iron and of silicon in commercial aluminum. This publication is now ready for distribution and copies may be obtained by addressing a request to the Bureau.

INCORPORATIONS

Stuart, Fla.—Stuart Public Service Co. has been incorporated with a capital of $50,000. Geo. R. Hilty, president; J. A. Philips, secretary.

Delray, Fla.—Delray Utility Co. has incorporated with a capital of $10,000. Address D. K. Carter, general manager.

Chicago, Ill.—Paramount Electric Co. has been incorporated with capital of $10,000 by Joseph Vickman, Leonard Cohn and Joseph Rosenberg.

Ventnor City, N. J.—Valentine Engineering Co. Capital, $100,000. To engage in a general electrical engineering capacity. Incorporators: M. G. Valentine, Alfred B. Ripel, and W. F. Sooy.

New York, N. Y.—Manhattan Lamp Works, Inc. Capital, $10,000. To manufacture electric lamps and kindred appliances. Incorporators: G. P. Leberthon, M. Burkelman, and F. R. Geering, 44 Seventh avenue, Brooklyn.

Brooklyn, N. Y.—Hygrade Lighting Fixture Corp. Capital, $10,000. To manufacture electric and gas fixtures, etc. Incorporators: H. S. Axelrod, H. Cohn and P. L. Woodward, 115 Broadway.

Rome, N. Y.—Halstead Wire Co., Inc. Capital, $50,000. To manufacture wires, cables, and kindred products. Incorporators: F. W. Wallace, Plainfield, N. J.; J. P. Halstead, and H. T. Dyett, Rome.

Tamaqua, Pa. — Souder, Hornsley Co. Incorporated under Delaware laws with a capital of $100,000. To manufacture heat regulating apparatus. Incorporators: Daniel F. Graham, Robert H. Souder, and John H. Hornsley.

Decatur, Ill.—Argenta-Warrensburg Electric Co. has incorporated with a capital of $25,000 by Lloyd W. Brown, III, M. Bekemeyer and G. N. Conover. The principal office is in the new Suffern building in Decatur.

Newton, Ga.—Application has been made for incorporation of Southwest Georgia Power Co., and Baker County Power Co., to develop water power on Notchaway Creek, use of one of two or more sites being contemplated. It is proposed to furnish electricity at different points in southwest Georgia. Address R. L. Hall.

Indianapolis, Ind. — Stutz High Duty Fire Engine Co. has been incorporated with capital of $250,000 to manufacture motor-driven fire engines. The company is independent of the Stutz Motor Car Company although several of the directors will be identical. Among the Stutz Motor Car Company men interested are W. N. Thompson, secretary and treasurer; Edward G. Sourbier, Frank H. Wheller and Martin M. Hugg.

Personal

W. R. Kenney Elected President of Pennsylvania Electric Association — M. H. Wagner Joins Kelso Co. — Changes

BURTON R. STAIR, Seattle, has taken over the agency of the Independent Pneumatic Tool Co., of Aurora, Ill., manufacturer of Thor electric tools.

W. M. STRONG, hydroelectric and mining engineer, formerly of Denver, Colo., has opened an office in Alaska building, Seattle, Wash.

J. E. CRILLY has severed his connection with the National Conduit & Cable Co. to become Pacific Coast representative of the Habirshaw Electric Cable Co., with headquarters at the San Francisco office of the Western Electric Co.

E. H. BULL, who for seven years has served the Green Engineering Co., East Chicago, Ind., in the capacity of engineer, is now a member of the firm of Bull & Liversparger, which has been appointed sales representative of the Green company in Chicago and northern Illinois territory.

WILLIAM H. CHURCHMAN recently severed his connection with the East Bay Water Co., Oakland, Cal., as superintendent of pumping stations, and has become constructing and erecting engineer of steam, electric and hydraulic machinery with the California Hydraulic Engineering & Supply Co., San Francisco, Cal.

H. E. CAVE, for a number of years a member of the Benson Lighting Fixture Co., Baltimore, Md., has severed his connection with that concern to take charge of the sales department of the Luminous Specialty Co. of Indianapolis, Ind. Mr. Cave's wide experience in artistic decorating and lighting will doubtless prove invaluable in pushing the sales of the Luminous Specialty Co.

MAJ. ALLEN E. RANSOM recently returned from France and joined the Westinghouse Electric International Co. as special representative in the west coast of South America with headquarters at Valparaiso, Chile. He was formerly a sales engineer with the Seattle office of the Westinghouse company, and was later identified with other machinery interests. During the war Major Ransom served as chief electrical engineer for the St. Nazaire base and later as major commanding the 137th engineer battalion.

GEORGE M. WOOD has been appointed supervisor of power plants for the Connecticut Co., New Haven, Conn. Mr. Wood has been connected with the Connecticut Co. in the power department for about eight years, first serving for two years as draftsman and later being connected particularly with erecting jobs on the company's plants and heating systems. In 1913 he was made assistant engineer in the operating department, and in 1915 was transferred to the construction department. He was graduated from the Sheffield Scientific School of Yale University in 1908, with the degree of Ph.B.

T. AROSIN, who has been engaged in power construction work in Portland, Ore., has accepted the appointment of station operator of the Isleton (Cal.) plant of the Great Western Power Co.

SIG. NORMAN is back with the Page & Hill Co. after 20 months' service in France with the 20th Engineers. Mr. Norman was on board the *Tuscania* when it was sunk, but was rescued. He has taken up his station with the Page & Hill Co. as assistant manager of the Newport, Wash., office.

MILTON H. WAGNER, electrical engineer on the staff of the Bureau of Standards, Washington, D. C., resigned August 25 to become associated with the

Milton H. Wagner.

Charles M. Kelso Co., industrial engineer and contractor, Dayton, Ohio, as manager of the electrical department. Mr. Wagner received the degree of electrical engineer at the University of Cincinnati in 1908, since which time he has been connected with the power and mining engineering department of the General Electric Co., Schenectady, N. Y., and the Dayton (Ohio) Power & Light Co. Mr. Wagner was in charge of the entire transmission and distribution system of the Dayton company, during which period he was chairman of the Transmission and Distribution Committee of the Ohio Electric Light Association and a member of the Overhead Lines Committee of the National Electric Light Association. During the war Mr. Wagner entered the Government service as power engineer for the United States Fuel Administration, Washington, D. C., and later was appointed electrical engineer on the staff of the Bureau of Standards for the purpose of assisting in the formulation of safety standards in connection with the design, construction and operation of the central stations and their transmission and distribution systems and all industrial electrical installations.

J. B. ERBLANG has been appointed auditor of the Northern States Power Co., Faribault division, succeeding H. O. Alm.

M. E. KEEFE, formerly with the Mercantile Bank of America, has joined the sales force of H. M. Byllesby & Co. at the New York office.

LIEUT.-COL. C. F. HIRSHFIELD recently received his discharge from the service and returned to his old duties at the Detroit Edison Co.

CHARLES EDISON, of Thomas A. Edison Co., West Orange, N. J., has become treasurer of the National Social Unit Organization, a society organized for the promotion of community development and organization.

A. J. SCHOOBEIN, who has been an assistant in the accounting department of the Fort Wayne, Ind., branch of the General Electric Co., has been named head of the accounting department to succeed J. H. Lotz, who has taken a position as traveling auditor with headquarters at Schenectady, N. Y.

D. C. HOPPER, formerly assistant superintendent of underground cable system, Commonwealth Edison Co., Chicago, and more recently in charge of the electric distribution and signal systems of the American International Shipbuilding Corp., is now connected with the Newport News & Hampton Railway, Gas & Electric Co.

J. E. LYNCH has returned to the Page & Hill Co., producer and dealer in cedar poles, and has taken over the management of the firm's Chicago office. He served in France with the 311th Engineers. Mr. Lynch enlisted as a private and received promotion to the rank of lieutenant shortly after the signing of the armistice.

F. H. SWAYSE, who for a number of years has been connected with the Western Electric Co., has been appointed eastern district line material manager. He was first employed in the general auditing department of the American Telephone & Telegraph Co. about 18 years ago and after one year was transferred to the purchasing department. He joined the Western Electric Co. in January, 1904, when that company absorbed the purchasing department of the A. T. & T. Co. The Western Electric Co. immediately organized its cedar and chestnut timber operations in North Carolina and Tennessee into a separate corporation called the Carolina Pole Co., Mr. Swayze acting as assistant treasurer and later as manager. In 1907 he was transferred to Philadelphia for field work under the dean of them all in chestnut poles, H. P. Marshall, and in

1909 was given charge of that work in the territory of the Philadelphia house, Pittsburgh house territory having later been added.

BRIG. GEN. GEORGE H. HARRIES, head of the American military mission in Berlin and in private life a vice-president of H. M. Byllesby & Co., has left that city with his staff homeward bound, via Copenhagen. General Harries was the first United States officer in Berlin a few weeks after the armistice, and from his headquarters in that city has performed service of the most important kind with distinguished success.

E. H. WADDINGTON, recently appointed western district manager, line material department of the Western Electric Co., with headquarters at St. Louis, Mo., entered the employ of the company in 1910 and was located with the Minneapolis branch for about two years as lamp, fixture and street lighting specialist. For the past five years Mr. Waddington has been connected with the St. Louis branch, handling syndicate and large industrial business. During the period of the war he was responsible for all transactions with the Government in his territory. He is president of the St. Louis Electrical Board of Trade.

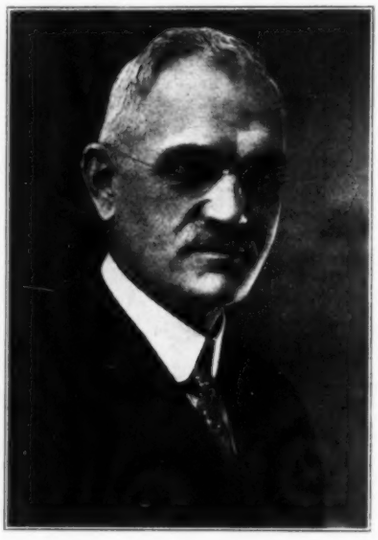
CAPT. LUCIUS A. FRITZE, Sanitary Corps, U. S. Army, has become associated with the technical staff of Wallace & Tiernan Co., Inc., New York City, manufacturer of chlorine control apparatus. Captain Fritze, who was sanitary officer of the Rainbow Division, after the armistice was assigned to the office of the Surgeon General in Washington and while there prepared a history of the Sanitary Corps of the A. E. F. Captain Fritze will be the manager of a new office which the Wallace & Tiernan Co. is opening at Kansas City, Mo., serving territory comprised in the states of Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Kansas and Missouri.

PHILIP K. CONDICT, recently appointed vice-president of the International Western Electric Co., in recognition of his service to the telephone and telegraph development in Japan, has had conferred upon him by that nation the Order of the Rising Sun, Fourth Class, an honor that comparatively few Americans have received. The ceremony took place on July 17, at the official residence of the Minister of the Department of Communications in Tokyo. Mr. Condict has been connected with the Western Electric Co. since his graduation from Yale in 1903, with the exception of the time he served as a major in the Signal Corps during the war. He has spent a number of years in foreign fields, and for six years was secretary of the Nippon Electric Co., Ltd., an allied company of the Western Electric Co. in Japan.

E. K. HALL, formerly vice-president of the New England Telephone & Telegraph Co, returned to the Bell System on Sept. 1 as vice-president of the American Telephone & Telegraph Co. He will be associated with N. C. Kingsbury, who is first vice-president in charge of the operation, and will give particular attention to relations with the personnel. His connection with telephone matters began some twenty years ago when he entered the Boston law firm of Powers & Hall, who were the attorneys for the New England Co. of which he later became vice-president and a director. Mr. Hall is a graduate and a trustee of Dartmouth College. He was a famous all-around athlete in college and he has been actively identified with college athletics ever since. For several years he has been chairman of the American Inter-Collegiate Football Rules Committee.

Mr. Hall was business director of the Students' Army Training Corps during the war, remaining in the War Department after the armistice, in charge of settling the contracts between the department and the college. He has long been closely connected with the Boston Chamber of Commerce of which he was vice-president, and he represented that body in the National Council of Chambers of Commerce of the United States. He is widely known, not only as a telephone executive, but also as an authority on civic matters and on business and public relations. Since January, 1917, he has been vice-president of the Electric Bond & Share Co. of New York.

W. R. KENNEY was elected president of the Pennsylvania Electric Association at its convention in Bedford Springs last week. The new president



W. R. Kenney.

has been identified with the electrical industry in Pennsylvania during his whole career. Beginning in the modest capacity of electrican's helper he rose to the position of superintendent of the Westmoreland County Light, Heat & Power Co., Greensburg, Pa., and of the Greensburg & Southern Railway Co., continuing in the same capacity when these companies became a part of the West Penn Power Co.'s system in 1903. Five years later he was transferred to Connellsville to become superintendent of light and power of Division A of the West Penn Power Co., which position he now holds. Mr. Kenney has been particularly ardent in his support of association activities, having given unstintingly of his experience, knowledge and enthusiasm to the National Electric Light Association and the Pennsylvania Electric Association, eminently fitting him for the important and responsible duties of chief executive of the latter organization.

E. M. CUTTING, formerly Pacific Coast manager of the Edison Storage Battery Co., with headquarters at San Francisco, has been appointed manager of the company's railroad department with headquarters at Orange, N. J. In 1888 he entered the employ of the Southern Pacific Co. in the signal department, and rose to the position of signal supervisor for the western division by 1897. In 1905 he was also given charge of the car-lighting on the Southern Pacific lines and in 1908 became engineer of train lighting, heating and ventilation and in 1912 he resigned to accept the position of Pacific Coast manager of the Edison Storage Battery Co. Mr. Cutting has always taken an active interest in electrical affairs, having been instrumental in initiating the movement which culminated in the Association of Railway Electrical Engineers, of which he was the second president, and also being a past president of the San Francisco Electrical Development League. He is widely known on the Coast, and while his friends will be pleased to learn of his new advancement, they will regret his removal from the electrical field on the Pacific Coast.

A. G. NABORS, formerly district pole manager of the Western Electric Co., Chicago, has been promoted to the position of central district pole line material manager. He has been affiliated with the Western Electric Co. since 1905, prior to which time he was for five years employed with the American Telephone & Telegraph Co. in the capacity of paymaster of a line construction gang and at other jobs in connection with building telephone lines. The last position he held with the company was in the pole line inspection department. When the purchasing and inspection of poles was transferred by the telephone company to the Western Electric Co. he was transferred to the latter company. He was located at its New York and Philadelphia offices for three or four years and was then sent to the Pittsburgh office. In July, 1916, he was transferred to Chicago to take the positon of district pole manager, which position he held until his recent promotion.

E. P. PECK, for more than thirteen years a member of the engineering staff of the Georgia Railway & Power Co., was recently appointed general superintendent of the electrical department of the Utica (N. Y.) Gas & Electric Co. Mr. Peck was born in Atlanta, Ga., Aug. 13, 1882, and attended the Georgia School of Technology. In 1903 he took up practical work, and for two years was connected with electrical construction, maintenance and repair work in northern cities. In 1905 he entered the employ of the Georgia Railway & Electric Co., serving in the repair and meter shops. One year later he was appointed foreman of the testing department, continuing this position until 1912, at which time he was promoted to assistant electrical engineer in charge of electrical station layouts and construction and of testing. Five years later he was again advanced to superintendent of operation. This position he held until October, 1918, when he resigned to take up war work in Washington, D. C. Mr. Peck has an extensive operating experience and is well known in the industry because of his original investigations and development work as a member of the Georgia Railway & Power Co.

For the Readjustment Period—What?

LI.

A Letter and Its Answer

GREAT LAKES TRUST CO.,

CHICAGO, ILL.

August 29, 1919.

DEAR MR. TUPPER:

In the face of great prosperity we have unrest and turbulent thought which, for the moment at least, finds expression in the slogans "Down with the High Cost of Living," "Increased Wage and Shorter Hours," "Government Licensing of Industry," "Government Ownership."

It seems to us well worth while to ascertain the personal views of a number of those who really think and who have an opportunity to measure and test conditions.

The enclosed report of interview with Harry H. Merrick is, of course, merely an expression of his opinion. A brief expression of your opinion on the problems will be appreciated by us and will be treated as confidential unless you authorize us to use your letter or some part thereof.

Yours very truly,

J. C. JOHNSON,
Vice-President.

INTERNATIONAL TRADE PRESS, INC.,

CHICAGO, ILL.

September 3, 1919.

DEAR MR. JOHNSON:

Replying to your letter of August 29, I would say: I have read with great interest the interview given to the Economist by friend Merrick, and I believe that it states very clearly and concisely the fundamental conditions for recovery from the industrial evils now so seriously affecting the prosperity of the country.

In my judgment, the less governmental agencies have to do with anything, nowadays, the better it is for the American people. I think it is time to call a halt on the increasing activity of governmental departments, bureaus and commissions, and to restore the control of industry and commerce to as nearly a pre-war basis as possible.

The remedy for high prices is unquestionably increased production, coupled with restriction of expenditures to necessities and a reasonable amount of luxuries.

Some expenditures are, of course, in the nature of real "economy." For example, the installation of a modern system of shop lighting which eliminates eye-strain and increases the productive capacity of workmen, or the purchase of a steam shovel to take the place of a gang of laborers on highway or construction work, bring benefits which far transcend the cost incurred; and the same is true of any system or mechanical improvement which tends to better working conditions. In general, however, large sums of money are being uselessly expended, and the chief offender in this respect is probably the government itself.

I think that the widespread circulation of common-sense views such as those expressed by Mr. Merrick has a very good effect on the industrial world by tending to check hysteria and to steady the minds of business men generally, and both for myself and for the INTERNATIONAL TRADE PRESS I want to express my appreciation of them.

Thanking you for your letter, and with best wishes, I am

Very truly yours,

C. A. TUPPER,
President.

Financial News

Price Stabilization Approaching.

Due to the continued operation of the factors which resulted in the present high prices, stabilization of prices at new levels is approaching, is the opinion expressed by the National Bank of Commerce in New York in its market letter in the September issue of the bank magazine, Commerce Monthly. The bank says:

"It is the conviction of the business world that high, or at least rising prices, are evidences of a satisfactory situation. This conviction has a basis in fact, in that high or rising prices stimulate increased productive and commercial activity. Our high prices are unquestionably the product of a world-wide curtailment of production and increase of consumption, as a result of the war, of those goods necessary to a peace-time life; of an increase in the circulating medium and an expansion of credit which the conflict through which the world has just passed rendered inevitable; and of the increased margins of profit deemed necessary to meet the risks involved in a period of rising prices. The era of extravagance which has followed the restrictions of war has also been a factor in raising prices. When the buying public seems not only willing but anxious to purchase, regardless of cost, prices respond as a result of what appears to be a shortage of stocks when measured by demand.

"Even though actual hostilities are now ten months behind us, the causes which have resulted in present prices are largely operative and it seems likely that stabilization at a new price level is approaching.

"In periods of rapidly rising prices, the commercial and financial activity resulting is likely to increase out of proportion to the growth in productive activity on which it must ultimately be based. Although the actual physical adjustment of American production to post-war demands has been more rapid than the most optimistic could have hoped, production has not yet expanded to what must be its normal post-war level.

"Prosperity has but one possible basis. That basis is production. Volume of business in tons and dozens and bales is its true measure. There is now no fundamental reason to deter production and not until it has increased to its new peacetime proportions can we rest in the assurance that as far as its effects on our economic life are concerned, the war has passed into history. To this end, every man and woman industrially or commercially employed must produce to capacity. Not only is production essential, but capital must be accumulated at a rate rapid enough to offset the destruction which took place during five years. The consuming public must recognize that it cannot continue indefinitely the scale of expenditure which followed as a reaction from the self-denial of war, but that thrift for personal benefit is as essential as thrift for one's country. When every individual capable of gainful employment is producing to capacity and spending conservatively, our economic adjustment will be complete."

Report of Municipal Railway.

Formal statement of the operation of the Seattle street railway for the first three months under municipal ownership has been filed with the City Council by Superintendent Thomas F. Murphine. The city began the operation April 1 and the statement shows that a net profit of $6,808.81 was made during the first three months.

Revenues from all sources amounted to $1,299,039.68, an increase of $163,916 compared to the corresponding period in 1918 and $186,720 compared to the first three months of 1919. Operating expenses in April, May and June were $1,093,449, an increase of $236,331 compared to the cost of operating the previous three months. This increase, Superintendent Murphine states is due to the increased service and higher wages to the street railway employes. The maintenance and other expenses also were heavier than during the previous three months.

Pennsylvania Commission Abolishes Minimum Rate.

The Public Service Commission of Pennsylvania, has handed down a decision abolishing the minimum charge heretofore made by the Panther Valley Electric Co. at Coaldale, Summit Hill and neighboring communities, covering a monthly sum. Under a former tariff, the charge was made for actual service rendered, with added charge for meter service when the amount was less than one dollar. The company did not base its schedule on the necessity of earning more revenue in order to declare a reasonable dividend, and the commission therefore considers that the returns under the former schedule are adequate.

Public Utility Bond Issues.

Public Service Commission has granted permission to the following companies to issue securities in the amounts noted, to be used in part for proposed extensions, betterments and for general operations: State-Center Electric Co., bonds, $474,000; Penn Public Service Corp., Johnstown, common stock, $3,350,000, and preferred stock, $1,517,700; West Penn Traction Co., Pittsburgh, bonds, $295,500; Girard Water Co., Philadelphia, common stock, $450,000; Mahoning & Shenango Railway & Light Co., New Castle, notes, $25,100; Overbrook Steam Co., Philadelphia, bonds, $25,000.

Great Western Power Sells Stock.

A syndicate composed of Stephens & Co., Girvin & Miller and Le Roy T. Ryon & Co., San Francisco, is offering $1,500,000 7% cumulative preferred stock of the Great Western Power Co. of California at par. Earnings for the twelve months ended June 30, 1919, were: Gross, $5,084,441; surplus available for preferred dividend, $954,269; preferred dividends, $121,254; balance, $834,006.

Earnings.

EL PASO ELECTRIC CO.

Gross earnings:	1919.	1918.
July	$ 123,184	$ 99,958
12 months	1,401,485	1,268,851
Net earnings:		
July	28,300	29,003
12 months	390,349	431,939

DUQUESNE LIGHT CO.

Gross earnings:	1919.	1918.
July	$ 893,577	$ 917,693
7 months	6,960,895	6,274,722
Net earnings:		
July	281,308	337,815
7 months	2,550,496	1,997,045

NORTHERN TEXAS ELECTRIC CO.

Gross earnings:	1919.	1918.
July	$ 278,076	$ 251,535
12 months	2,953,938	3,139,472
Net earnings:		
July	109,665	102,488
12 months	1,105,803	1,446,010

SOUTHERN CALIFORNIA EDISON.

Gross earnings:	1919.	1918.
July	$ 897,046	$ 706,534
7 months	5,171,033	4,162,214
Net earnings:		
July	475,881	452,421
7 months	2,969,937	2,410,962

Dividends.

The Muskogee Gas & Electric Co. has declared a quarterly dividend of 1¾% on preferred stock, payable Sept. 15 to stockholders of record Aug. 30.

Niagara Falls Power Co. has declared a quarterly dividend of 1% on common stock, payable Sept. 15 to stockholders of record Sept. 10. A quarterly dividend of 1¾% has also been declared on preferred stock, payable Oct. 15 to stock of record Sept. 30.

Oklahoma Gas & Electric Co. has declared a quarterly dividend of 1¾% on preferred stock, payable Sept. 15 to stock of record Aug. 30.

Pennsylvania Water & Power Co. has declared a quarterly dividend of 1½%, payable Oct. 1 to stockholders of record Sept. 19.

Cities Service Co. has declared the monthly dividend of 51 cts. on bankers' shares, payable Oct. 1 to stock of record Sept. 15.

American Public Service Co. has declared a quarterly dividend of 1¾% on preferred stock, payable Oct. 1 to stock of record Sept. 15.

The board of directors of the Buffalo General Electric Co. has declared a quarterly dividend of 2%, payable Sept. 30 to stock of record Sept. 20.

The board of directors of the American Telephone & Telegraph Co. has declared a dividend of $2 per share, payable Oct. 15 to stock of record Sept. 20.

A quarterly dividend of 1¾% on preferred stock has been declared by the Central States Electric Corp., payable Oct. 1 to stock of record Sept. 10.

DETROIT EDISON CO.

(Including all constituent companies.)

	Month of July, 1919.	Month of July, 1918.	7 months of 1919.	7 months of 1918.
Operating Revenue:				
Commercial electric revenue	$1,055,281.90	$ 896,274.03	$7,436,519.43	$6,304,872.41
Municipal electric revenue	29,700.28	26,956.08	199,903.23	183,044.12
Sales to street railways	86,614.76	71,242.32	546,309.46	494,371.04
Sales to other public service corp'ns.	13,697.37	12,193.00	100,348.13	86,155.37
Miscellaneous revenue	570.00	1,386.48	4,440.95	22,438.79
Non-Operating Revenue:				
Steam sales	11,109.63	7,760.96	633,761.63	537,254.82
Other non-operating revenue	27,631.96	13,699.71	140,383.08	94,208.74
Total gross revenue	$1,224,605.90	$1,029,512.58	$9,061,665.91	$7,722,345.29
Expenses:				
Operating and non-operating (except renewal, replacement and contingent)	$ 870,495.38	$ 738,103.01	$6,145,026.93	$5,223,516.55
Renewal, replacement and contingent (depreciation reserve)	79,995.00	67,600.00	432,000.00	419,605.00
Total operating and non-operating expenses	$ 950,490.38	$ 805,703.01	$6,577,026.93	$5,643,121.55
Net income	$ 274,115.52	$ 223,809.57	$2,484,638.98	$2,079,223.74
Deduction from Income:				
Interest on funded and unfunded debt.	$ 140,152.02	$ 112,666.80	$ 965,892.65	$ 717,445.44
Other deductions	.....	.....	.....	.....
Total deductions	$ 140,152.02	$ 112,666.80	$ 965,892.65	$ 717,445.44
Net	$ 133,963.50	$ 111,142.77	$1,518,746.33	$1,361,778.30